THE

General Gauger:

OR, THE

Principles *and* Practice

OF GAUGING

BEER, WINE, *and* MALT.

CONTAINING,

I. Decimal Arithmetick, the Extraction of the Square and Cube Roots, and the Uſe of them in the Way of *GAUGING*.
II. The Neceſſary Problems in Geometry relating to *Gauging* and *Meaſuring*.
III. The Uſe of the *SLIDING-RULE* in Meaſuring Timber, and other Surfaces and Solids.
IV. The Theory and Practice of *GAUGING* in all the Varieties, perform'd by *Pen*, and *Sliding-Rule*. Each Propoſition being Wrought in *Beer*, *Wine*, and *Malt*.
V. The Conſtruction of the Table of *Segments*, and all the Varieties of Ullaging of Caſks.
VI. A Table of *Areas* in Malt Buſhels, &c.
VII. An APPENDIX for meaſuring Boards, Timber, Stone, &c. With Rules and Examples for meaſuring moſt Sorts of ſuperficial and ſolid Figures: Alſo Surveying of Land.

The Whole laid down more methodically than any Performance of this Nature yet extant.

By *JOHN DOUGHARTY*, K
Teacher of the Mathematicks at *Worceſter*.

The Sixth Edition, Corrected by the Author.

To which is added,
A Table of the Areas of Circles, and Contents of Cylinders, in Ale Gallons, to all Diameters (in Inches and Tenths) from 12 Inches to 156: Together with the Deſcription and Uſe of the ſame.

LONDON:
Printed for JOHN and PAUL KNAPTON, in *Ludgate-ſtreet*.
MDCCL.

BRITISH MUSEUM

To the Honourable,

Foot Onſlow,
William Strong,
George Townſend,
Philip Ryley, } Eſqrs.
Sir *Marmaduke Wyvil*, Knight.
Edward Noel,
——*Mountague,* } Eſqrs.

Chief Commiſſioners and Governors for the Management and Receipt of Her Majeſty's Revenue of Exciſe, within the Kingdom of *England*, &c.

Honoured Sirs,

HAVING ſome Time to ſpare from my publick Buſineſs, I thought I could not ſpend it better than in compoſing Something for the Edification of young Officers. And having now finiſhed what I did deſign, and being perſuaded into a Reſolution to print it, I thought myſelf obliged, by the Nature of the Subject, humbly to dedicate the ſame to your Honours, as being the only Perſons that ſeem to encourage Induſtry of this Nature; as may be ſeen by the many prudent and ingenious Inſtructions which your Inferior Officers daily receive, to the great Advancement of Her Majeſty's Revenue, your own Everlaſting Honour, and the general Satisfaction of all Subjects, but particularly,

20 AP 63

Your moſt humble Servant,

John Dougharty.

THE

PREFACE.

THOUGH *the Subject I here treat of, has been accurately purſued by Men of Learning and Merit, yet I can't forbear ſaying, that Gaugers (for whoſe Benefit I chiefly write) have long been at a Loſs, for Want of a methodical Introduction, ſuited to the Capacities of Beginners, and adapted to the Practice in which they are employ'd.*

Moſt Books upon this Subject throw a Man directly into the Menſuration of Solids, without leading him gradually thro' the previous Parts of Knowledge, upon which the Doctrine and Calculation of the Menſuration of Solids is grounded: And by this Means it comes to paſs, that the general Practice of Gauging is done by Rote, and all that they know of the

Matter is precarious. Not to mention that their Taſk is much more difficult, when only the Memory is loaded with ſtiff Rule and Precept, than when the Judgment is called in, and the Conſequences of Practice are ſhewn to flow naturally, eaſily, and coherently, from the plain and diſtinct Grounds laid down before.

'Twas upon this Conſideration that I chalk'd down the Method here obſerved. I begin with the firſt and ſimpleſt Principles, and ſo riſe gradually to what is built upon 'em. 'Tis acknowledged on all Hands, that the Calculation of Gauging is moſt expeditiouſly and conveniently done by that Sort of Arithmetick which is call'd Decimal; *and which, for Facility and Diſpatch, has much the Advantage of the vulgar Fractional Way. For this Reaſon I begin with a regular and plain Account of all the Operations of Decimal Arithmetick; taking Care ſtill to apply the Examples to the Subject of a Gauger's Imployment, that he may ſee the Uſe and Neceſſity of this Part of Knowledge in his Way.*

Next is the Extraction of the Square and Cube Roots, the Uſe of both which is illuſtrated in ſuch Geometrical Problems, as lead to, and *are the Foundation of, the Menſuration of Solids, of which Gauging is a Part.*

This done, I conduct my Reader to the Doctrine of Proportions contain'd in the Rule of Three, and ſhew the uſeful and ready Application of it in ſuch Problems as give Light to the Practice of Gauging.

Having thus prepared my young Gauger, I ſhould have led him directly to the Gauging Part; but that I thought myſelf obliged to give him to underſtand the Uſe and Practice of a very uſeful Inſtrument, called the Sliding-Rule, *which ſhortens the Calculation. This I exemplify and apply to all the Caſes above-mentioned, that the young Scholar may now apply himſelf to the Gauging Part, being equally qualified for working the Rules both by Pen and Inſtrument.*

As for the Practice of Gauging itſelf, to which all the above-mentioned Parts are but Preliminaries, I apply it to all the Varieties requiſite; and diſcuſs each Propoſition both by Pen and Sliding-Rule, in it's proper Place. For the greater Conveniency of the Reader, and the Illuſtration of the Matter, I clear every Propoſition, by Rule, by Examples, by

Operation, and by proper Schemes. The Examples I make Uſe of are in Beer, Wine, and Malt; and the Operation is perform'd both by Pen and Sliding-Rule.

For the farther Inſtruction and Satisfaction of the young Gauger, I have added, at the latter End, a Table of Circles Areas in Malt Buſhels: Alſo a Table of the Areas of Circles, and Contents of Cylinders, &c. *in Ale Gallons, to all Diameters (in Inches and Tenths) from* 12 *Inches to* 156*: Together with a Table for gauging right-lined Figures.*

Such are the Method, Deſign, and Contents of the Treatiſe I here publiſh: And tho' I cannot be ſo vain as to plead much upon it's Merit, yet I hope the Plainneſs and Eaſineſs of the Method, and the natural Application of it's Rules, will atone, in ſome Meaſure, for it's Imperfections.

Worceſter,
March 25, 1750.

20 AP 63

The CONTENTS.

Of Decimal Arithmetick. Page 1

To extract the Square Root. 16

The Uſe of the Square Root. 20

To find the Diameter of a Circle, which ſhall be equal in Area to an Oval, &c. 21

To find the Side of a Square, which ſhall be equal in Area to any given Surface. 22

Having given any two Sides of a Right-angled Triangle, to find the third Side. 23

To find the Diameter of the Baſe of a Cone, by having the Slant, Heighth, and Perpendicular. 26

By having the Bung, Heads, and Length of a Caſk, to find the Diagonal. 27

By the Diameter and Diagonal, to find the Length. 28

The Uſe of the Cube-Root. 36

Having the Bottom and Top Diameters and Length of a Conical Tun, alſo the Content, to know the Diameters and Depth of another Conical Tun which will hold any given Number of Gallons. 37

To calculate Diagonal Tables for the middle Fruſtum of a Spheroid. 38

The Rule of Three applied to Gauging. 40

Having the Diameters and Depth of a conical Tun, to find the Depth of the whole Cone. 44

Having the Heighth of a Cone, and the Diameter of it's Baſe, to find the Diameter at any Depth 45

Having the Diameter of a Circle, to find it's Circumference. 46

Having the Circumference of any Circle, to find the Diameter. 47

To find the Duty of any Number of Groſs Buſhels of Malt. 49

The Uſe of the Sliding-Rule, from Page 49, *to Page* 60

The Uſe of the Square Root by the Sliding-Rule. 60

To find a mean Proportional between two given Numbers. ibid.

Having the tranſverſe and conjugate Diameters of an Oval, to find the Diameter of a Circle equal to it. 61

Given the Diameter of a Circle and verſed Sign of it's Segment, to find the Chord Line. 61

Extraction of the Cube Root by the Sliding-Rule. 62

The

The Uſe of the Cube Root by the Sliding-Rule, from Page 63 *to Page* 67
The Uſe of the Sliding-Rule in meaſuring Timber, both Round and Square, from Page 68, *to Page* 84
Gauging 84
To gauge a Square. 86
To gauge a Parallelogram. 39
To gauge a Rhombus. 91
To gauge a Triangle. 93
To gauge a Trapezium. 95
To gauge a Hexagon. 97
To gauge a Circle. 99
To gauge a Sector of a Circle. 101
To gauge an Oval. 103
To find the Circumference of an Ellipſis, by having the Tranſverſe and Conjugate Diameters given. 105
Another Way to do the ſame by a Series. 106
A Table for the ſame Purpoſe, by Sir Jonas More. 107
The Uſe of the Table. 108
To gauge the Segment of a Circle. ibid.
Another Rule for finding the Area of the Segment of a Circle. 111
Notes upon the foregoing Examples. 117
To gauge a Cube. 119
To gauge a Parallelopipedon. 121
The Uſe of the Reverſe-Line mark'd M.D. *for Malt Depths.* 123
To gauge a Priſm. ibid.
To gauge a Cylinder. 125
To gauge a Cone. 127
To gauge a Square Pyramid. 129
To gauge a Parabolick Conoid. 132
To gauge a Hyperbolick Conoid. 134
To gauge a Spheroid. 136
To gauge a Globe. 138
To gauge an Elliptick Cone. 140
To gauge the Fruſtum of a Cone. 142
To gauge the lower Fruſtum of a parabolick Conoid. 146
To find the Content of any Tun, whoſe Sides are ſtreight, and Baſes Parallelograms or Ellipſes. 150

To gauge the Fruſtum of an upright Elliptical Cone. Page 152
To gauge the Fruſtum of a Globe. 158
Caſk Gauging. 161
To gauge the middle Fruſtum of a Spheroid. 163, 170
To gauge the middle Fruſtum of a paraboliek Spindle. 170
To gauge the middle Fruſtum of two Conoids. 171
To gauge the middle Fruſtum of two Cones, abutting on a common Baſe. ibid.
To gauge Caſks by the Sliding-Rule. 173
To find ſecond Gauge Points on the Rule. 174
To find the Ullage of a Caſk. 178
The Table of Segments. 180
The Conſtruction of the Table of Segments. 181
To calculate any Diameter between the Bung and Head of a Spheroid, poſited perpendicularly to the Horizon. 184, &c.
To find the Ullage of a Caſk lying. 190
To find Ullages by the Rule. 191, 196
To find the Drip or Fall of a Tun. 196, &c.
How Diviſors may be found, by knowing what Proportion their reſpective Figure hath to it's circumſcribing Cylinder or Parallelopipedon. 203
Having the Diviſors for Beer, Wine, and Malt, of a Cylinder, to find the Diviſor for a Cone. 205
To gauge a Copper, allowing for the Riſing Crown. 207
To find the Diameter of a Copper's Crown. 208
Having the Diameter and Depth of any conical Tun, to find the Diameter at any Depth. 210
To find how many Gallons a conical Tun will hold upon every Inch of the Depth. 213
To find the Diameter at any Depth of the Fruſtum of a parabolick Conoid. 219
A Table of Circles Areas, in Malt Buſhels 221
A Table to gauge right-lined Figures, as Squares, Triangles, &c. Giving the Content of the Squares, from 21 *to* 120 *Inches in Breadth, and from* 30 *to* 310 *in Length, by Inſpection.* 231
A Table to gauge right-lined Figures, when the Dimenſions are taken in Inches and decimal Parts, as in Ciſterns, &c. 255
To find the Length of the Arch of a Circle geometrically. 280

To

The CONTENTS.

To find the Length of an Arch greater than a Semicircle. 281
A Table of the Areas of Circles and Contents of Cylinders, &c. 318
The Deſcription and Uſe of the foregoing Table 415

Lately Publiſhed,

Inſcribed to the Schoolmaſters of Great Britain *and* Ireland,

Mathematical Digeſts.

CONTAINING,

THE Elements and Application of Geometry and Plain Trigonometry, both by Inſtrumental Conſtruction, and by Calculation, to the meaſuring of Heights, Diſtances, *&c.* and the Stereographic Projection of Spheric Trigonometry, with Numerical Solutions, and the Application thereof to ſeveral curious and important Problems in Aſtronomy, Navigation, and Dialling; with Tables for finding the Places and Eclipſes of the Sun and Moon, according to the laſt Improvements of the Newtonian Theory.

With a Supplement, containing Tables for accurately and expeditiouſly finding the mean Times of the Moon's Phaſes and Eclipſes.

20 AP 63

By JOHN DOUGHARTY,

Author of the General Gauger; and Teacher of the Mathematicks at Worceſter.

Sold by J. and P. KNAPTON, in *Ludgate-ſtreet*, and
W. REEVE, in *Fleet-ſtreet.*

ADVERTISEMENT.

WRITING and Arithmetick, Vulgar, Decimal, Inſtrumental, and by the Logarithms, Algebraical and Geometrical: Alſo Trigonometry, both Plain and Spherical, with their Applications in Meaſuring Boards, Glaſs, Land, Timber, Stone, *&c.* Book-keeping, Gauging, Navigation, *i. e.* Plain, Mercator, and Great-Circle Sailing, Dialling, and Aſtronomy, are *Taught* by the AUTHOR, at his Houſe in *Worceſter:* Where Youth, for more Expedition, may be boarded.

THE General GAUGER, &c.

Of Decimal Arithmetick.

WHO was the Inventor of this Kind of Arithmetick is uncertain; however, the firſt that profeſſedly treated of this Subject, and gave it the Name of *Diſms* or *Decimals*, was *Simon Stevinus*, as Dr *Wallis* thought. But whoever it was, 'tis no matter, ſince our Thanks or Praiſe will do him no good; though indeed we ought to have a great Veneration for the very Name of ſuch Perſons whoſe Labours we are the better for.

It is certain that amongſt the ſeveral Inventions of Man, there is not any thing of greater Uſe than this moſt excellent Part of Arithmetick: Without which the moſt uſeful Parts of mixt Mathematicks would become ſo troubleſome, that it would hinder the moſt patient Soul from attempting any thing that is Praiſe-worthy.

An Officer in the Exciſe therefore ought not to be ſatiſfied with leſs than the very Grounds and Reaſons thereof, before he dare undertake to do any thing of Buſineſs. I have not inſiſted ſo much hereon as may be expected, yet what is done is very ſufficient to ſo ſmall a Tract as this.

Notation of DECIMALS.

A Decimal Fraction is ſuch a Fraction whoſe Denominator is never expreſſed in Operation, but always known to be 10, 100, 1000, 10000, *&c.*

And ſuch a Fraction is known from a whole Number, by having a Comma or Point ſet on the Left Side thereof.

Thus ,57 is a Decimal Fraction, whoſe Denominator is an 100, for the Denominator of a Decimal Fraction is an Unit with as many Cyphers ſet on the Right Side thereof, as there were Figures or Places in the Decimal given; ſo the Denominator of ,5 is 10, of ,25 is 100, of ,127 is 1000, and of ,02 is 100, *&c.* And theſe, or any one of the ſame Nature, may be expreſſed and read as a Vulgar Fraction; thus $\frac{5}{10}$ $\frac{25}{100}$ $\frac{127}{1000}$ $\frac{02}{100}$

Note, that as Cyphers placed on the Right Side of whole Numbers increaſe them in a decuple Proportion, ſo do Cyphers ſet on the Left Side of a decimal Number decreaſe them in the ſame Proportion.

EXAMPLE.

If on the Right Side of 6 you place a Cypher, it will be 60, which is ten times more than it was before; ſo if you place a Cypher before ,6 'tis 06, which is ten times leſs than before.

Alſo if you ſet Cyphers on the Right Side of Decimals, you'll increaſe the Value thereof no more than you'd do, if you had placed Cyphers on the Left Side of Integers.

EXAMPLE.

Let ,27 be a Decimal, on the Right Side of which if you place 5 Cyphers, 'twill ſtand thus ,2700000, but if we ſet

,27 over it's imagin'd Denominator 'tis $\frac{27}{100}$ and ,2700000 over it's proper Denominator 'tis $\frac{2700000}{10000000}$; now if we conceive the laſt as a Vulgar Fraction given to be reduced into it's loweſt Terms, 'tis done by taking as many Cyphers from the Denominator as from the Numerator, or cut ſo many off both, by a Daſh of your Pen, and 'tis $\frac{27}{100}\Big|\frac{00000}{00000}$ which ſhews it was not increaſed by thoſe Cyphers.

Addition of *Decimals*.

As in Addition of whole Numbers, ſo here only you muſt always remember to ſet Units under Units, and Primes under Primes, *&c.* then add them as Integers, placing a Comma in the Aggregate, under thoſe in the Sums given.

EXAMPLE.

l.	*l.*	*l.*
425,73	42,56	432,76
362,21	3,2	25,
43,56	,57	36,
5,23	,362	42,
6,547	,0521	33,
Sum 843,277	Sum 46,7441	,37
		Sum 569,13

ys.	*ys.*	*ys.*
87,642	763,57	428,27
,362	36,27	362,573
,353	36,27	621,
,423	62,75	321,
2,572	62,75	423,
,425	62,7232	23,
,00235	1024,3332	5,
91,77935		2183,843

In all the preceding Examples you may take notice that the Points in the Sums ſtand juſt under the Points in the Numbers given; which if you make before you begin to add them, the Figures will fall in their proper Places.

Addition of *Beer* or *Ale* Meaſure.

Note, That 34 Gallons (by an Act of the firſt of *William* and *Mary*) is one Barrel both of Beer and Ale; therefore the Firkin is 8½ Gallon, *i. e.* 8. 5.

	Bar.	*F.*	*Gal.*	*Bar.*	*F.*	*Gal.*	*Bar.*	*F.*	*Gal.*
	365	3	8,4	625	2	8,1	357	3	5,7
	325	3	7,1	57	3	2,2	825	2	2,6
	472	2	5,3	57	2	3,5	843	3	0,2
	846	2	5,7	82	3	7,4	562	2	0,5
	325	3	1,5	87	3	6,7	827	3	0,8
	365	2	1,7	57	2	5,7	423	0	0,2
				12	3	8,0			
Sum	2702	2	4,2	982	2	7,6	3840	2	1,5

In all theſe Examples, you are for every 8,5 Gallons (in the Gallons and Parts Place) to carry one Firkin to the Line of *F*, and for every 4 in the Line of *F* you are to take one to the Barrels. The very Examples anſwered are a ſufficient Explanation.

Subtraction of *Decimals*.

The ſame Rule is to be obſerved here as in Addition, *i. e.* in placing your Figures; for if you ſet the Point among the Remainders, under the Points in the Number given to be ſubtracted; after Units are ſet under Units, and Primes under Primes, *&c.* you'll have the true Place thereof.

EXAMPLE.

	l.	*l.*	*l.*
From	25,72	92,723	62,762
Take	12,972	4.32	19,2
Remains	12,748	88,403	43,562

	Gall.	*Gall.*	*Gall.*
From	72,027	72,63	4,
Take	12,	1,927	3,2657
Remains	60,027	70,703	0,7343

Subtraction of *Beer* Meaſure.

	Bar.	*F.*	*Gal.*	*Bar.*	*F.*	*Gal.*
From	365	2	7,5	272	3	5,5
Take	192	3	3,6	192	3	7,8
Remains	172	3	3,9	079	3	6,2

	Bar.	*F.*	*Gal.*	*Bar.*	*F.*	*Gal.*
From	962	3	2,5	836	2	2,7
Take	196	3	7,2	192	1	8,2
Remains	765	3	3,8	644	0	3,0

In the two laſt Examples, ſeeing you can't take 7,2 Gallons out of 2,5 Gallons, nor 8,2 out of 2,7; you muſt borrow one Firkin, *viz.* 8,5 Gallons, which add to 2,5 or 2,7, and take 7,2 and 8,2 out of the Sum, and the Remainder in one will be 3,8 and in the other 3,0; then pay what you borrow'd to it's proper Place, as you ſee is done in the foregoing Operations; which Method ought to be obſerved in all others of the ſame Nature.

Multiplication of *Decimals*.

GENERAL RULE.

Multiply as in whole Numbers, and from the Product (towards the Right Hand) cut off ſo many Figures as there are Decimal Places in both the Multiplier and Multiplicand; but if the Product conſiſteth not of ſo many Figures (as according to this Rule) you ought to cut off, you muſt ſupply the Defect by prefixing one or more Cyphers.

EXAMPLES.

	3,255	,3894	3,728
	3,26	,678	5,43
	19530	31152	11184
	6510	27258	14912
	9765	23364	18640
Products	10,61130	,2640132	20,24304

2,5623	,38602	,1235
,0235	,123	,036
128115	115806	7410
76869	77204	5705
51246	38602	
,06021405	,04748046	,0044460

In the three laſt Examples the Product did not conſiſt of ſo many Figures as by the general Rule ought to be cut off, therefore the Cyphers were prefix'd to make them ſo many.

Diviſion of *Decimals*.

GENERAL RULE.

You muſt always cauſe the Decimal Places in the Dividend to exceed thoſe in the Diviſor by about four or five, by ſetting Cyphers on the Right Side thereof, *&c.* then after the Work is done, prick off with your Pen from the Right Hand of the Quotient ſo many Figures as is the Exceſs; but if the Quotient conſiſteth not of ſo many Figures as by this Rule you ought to cut off, you muſt prefix ſo many Cyphers as will make them up ſo many.

EXAMPLES of all the Nine Caſes.

CASE I.

To divide a whole Number by a whole Number, ſet any Number of Cyphers behind the Dividend, *&c.*

```
236,) 2562,0000 (10,8559
      236
      ---
      2020
      1888
      -----
        1320
        1180
        -----
         1400
         1180
         -----
           2200
           2124
           ----
           ..76
```

CASE II.

To divide a mix'd by a whole Number.

96,) 58,3200 (,6075
576

720
672

480
480

0

Note, The Decimal was but ,32, and the two Cyphers were added to make the Decimals in the Quotient come nearer the Truth than before it would have done.

CASE III.

To divide a whole Number by a mix'd.

3,27) 325,0000000 (99,38837
2943

3070
2943

1270
981

2890
2616

2740
2616

1240
981

2590
2289

301

CASE IV.

To divide a whole Number by a Decimal Fraction.

```
,572) 3648,000000 (6377,622
      3432
      ----
       2160
       1716
       ----
        4440
        4004
        ----
         4360
         4004
         ----
          3560
          3432
          ----
           1280
           1144
           ----
           1360
           1144
           ----
            216
```

CASE V.

To divide a mix'd Number by a mix'd Number.

```
1,25) 325,7000 (260,56
      250
      ---
       757
       750
       ---
         700
         625
         ---
          750
          750
          ---
            0
```

CASE VI.

To divide a mix'd Number by a Decimal Fraction.

,543) 36,2500000 (66,7587
3258
3670
3258
4120
3801
3190
2715
4750
4344
4060
3801
259

CASE VII.

To divide a Decimal Fraction by a whole Number.

27) ,32000000 (,01185185
27
50
27
230
216
140
135
50
27
230
216
140
135
5

CASE VIII.

To divide a Decimal Fraction by a mix'd Number.

```
13,26) ,36205627 (,027304
        2652
        ----
         9685
         9282
         ----
         4036
         3978
         ------
         005827
           5304
           ----
            523
```

CASE IX.

To divide a Decimal Fraction by a Decimal Fraction.

```
,162), 8727587 (5,3873
       810
       ---
        627
        486
        ----
        1415
        1296
        ----
         1198
         1134
         ----
          647
          486
          ---
          161
```

Reduction of *Decimals*.

When the Parts of the Integer given are reduced to ſuch a Vulgar Fraction as is proper for the ſame, all ſuch Fractions are reduced to Decimal Fractions by the Proportion following.

That is,

As the Denominator of that Vulgar Fraction is to it's Numerator, ſo is 10, 100, 1000, 10000, or 100000, *&c.* to their particular Numerators, which Numerator is the Decimal required.

EXAMPLE I.

What Decimal Part of a Barrel of Beer is Five Gallons?

Becauſe in one Barrel are 34 Gallons, therefore the Vulgar Fraction will be $\frac{5}{34}$.

Then the Proportion to find the Decimal Fraction is as

```
34 : 5 : : 10000
               5
      ──────────
34)   5,0000   (,147 facit
      34
      ───
      160
      136
      ───
       240
       238
      ────
       02
```

EXAMPLE II.

What Decimal Part of a Gallon is two Pints?

In one Gallon are eight Pints, therefore the Vulgar Fraction will be $\frac{2}{8}$, *i. e.* $\frac{1}{4}$, and the Proportion is as

```
4 : 1 : : 100
  4)   100    (,25 facit
      2(0
```

EXAMPLE III.

```
                                              s.  d.
What Decimal Part of a Pound Sterling is     15 : 4 ?
                                             12
                                            ────
                                             34
                                             15
                                            ────
Or what Decimal Part of a Pound is          184 Pence ?
```

In One Pound is 240 Pence, therefore the Vulgar Fraction will be $\frac{184}{240}$, and the Proportion as 240 : 184 : : 100000

```
          184
240.)184,00000(,76666 Anſwer
     1680
      1600
      1440
       1600
       1440
        1600
        1440
         1600
         1440
          160
```

EXAMPLE IV.

What Decimal Part of a Pound Sterling is 3 : 4¾?

```
                                   12
                                   40
                                    4
as 960 : 163 : : 10000 : ,1697    163 Farthings.
         facit ,1697.
```

EXAMPLE V.

What Decimal Part of a Foot is 3 Inches?

The Number of Inches in One Foot is 12, therefore the Vulgar Fraction will be $\frac{3}{12}$, *i. e.* , and the Proportion is as 4 : 1 : : 100 : ,25.

```
4,) 1,00 (,25 facit
     2(0
```

When a Decimal Fraction is given to find the Value thereof.

RULE.

Multiply the Decimal given by ſo many of the next inferior Denomination as will make that Integer, of which the

given

given Decimal is a Part, and from the Product cut off ſo many Figures as there were Places in the Decimal given.

EXAMPLE I.

What is the Value of ,752 of a Pound Sterling?

20
15,040 Shillings
12
,480 Pence
4
1,920 Farthings

s. *d.* *qt.*
Anſwer 15 : 00 : 1,92

EXAMPLE II.

What is the Value of ,027 of a Pound Sterling?

,027
20
,540 Shillings
12
1080
540
6,480 Pence
4
1,920 Farthings

s. *d.* *qt.*
Anſwer 00 : 6 : 1,92

EXAMPLE III.

What is the Value of ,952 of a Pound Sterling?

20
19,040 Shillings
12
,480 Pence
4
1,920 Farthings

s. *d.* *qt.*
Anſwer 19 : 00 : 1,92

A more ſhort Way to find the Value of a Pound Sterling.

RULE.

Double the Figure which ſtandeth next the Point in the Decimal given; and if the next Figure towards the Right Hand the aforeſaid is 5 or more, add 1 to the Product; then what Figure ſtands in the ſecond Place, above or under 5, reckon ſo many Tens of Farthings, and what ſtands in the third Place from the Prick is ſo many Farthings; which, as often as they are above 13, make leſs by 1, or above 39, make leſs by 2.

EXAMPLE IV.

What is the Value of ,482 of a Pound Sterling?

9 : 7¼ *facit.*
s. *d.*

EXAMPLE V.

What is the Value of ,875 of a Hundred Weight Averdupoize?

4
3,500 Quarters.
28
14,000 Pounds.

q. *lb.*
Anſwer 3 14

EXAMPLE VI.

What is the Value of ,623 of a Barrel of Beer?

4
2,492 Firkins
8,5
2460
3936
4,1820 Gallons
8
1,4560 Pints

F. *G.* *P.*
Anſwer 2 : 4 : 1,456

To extract the *Square Root.*

TO extract the Square Root of any given Number, is to find a Number, which being multiplied into itſelf ſhall produce the Number given; and this is of great Uſe in Gauging, for finding Geometrical mean Proportionals, &c.

A Table of the Powers of the Digits from Gibſon's Syntaxis Mathematica, *the Figures at the Top ſhewing to what Power the Digits, or Roots, in the firſt Column are raiſed.*

Roots	2	3	4	5	6	7	8	9
1	1	1	1	1	1	1	1	1
2	4	8	16	32	64	128	256	512
3	9	27	81	243	729	2187	6561	19683
4	16	64	256	1024	4096	16384	65536	262144
5	25	125	625	3125	15625	78125	390625	1953125
6	36	216	1296	7776	46656	279936	1679616	10077696
7	49	343	2401	16807	117649	823543	5764801	40353607
8	64	512	4096	32768	262144	2097152	16777216	134217728
9	81	729	6561	59049	531441	4782969	43046721	387420489

When a Number is given whoſe Square Root is required, you muſt firſt make a Point over every other Figure beginning at the Place of Units, and ſo many Points as you have, ſo many Figures you may expect in the Root required.

EXAMPLE.

What's the Square Root of 472738, this being pointed (as above directed) is $4\dot{7}2\dot{7}3\dot{8}$, by which I conclude that the Root will conſiſt of three Figures, becauſe there are three Points over the given Square.

Your next Buſineſs is to find the Root of the greateſt Square to the firſt Point; which in this Caſe you'll find to be 6, for the Square thereof is 36, that being the next leſſer Square to the firſt Point, *viz.* 47; this 36 I take from

47, and place the Root 6 in the Quotient, and the Work will ſtand thus,

```
       .  .  .
      472738 (6
      36
      ----
      11
```

To the laſt Remainder I bring down all the Figures to the next Point, and then 'tis

```
       .  .  .
      472738 (6
      36
      ----
      1127
```

And for a Diviſor I double the Quotient, then it will be

```
       .  .  .
      472738
      36
      ----
  12) 1127
```

Now enquire how many Times 12 you can have in 112, which you may have 8 Times; ſet 8 behind the Diviſor, and alſo in the Quotient, and it will ſtand thus,

```
       .  .  .
      472738 (68
      36
      ----
 128) 1127
```

Multiply 128 by 8, and ſubtract the Product from 1127, and the Remainder will be 103, as below,

```
       .  .  .
      472738 (68
      36
      ----
 128) 1127
      1024
      ----
      103
```

To the laſt Remainder, I bring down all to the next Point, *viz.* 38, and double the Root 68, for a Diviſor, and it will be

```
       .  .  .
      472738 (68
      36
      ----
 128) 1127
      1024
      -----
 136) 10338
```

Then again enquire how many Times 136 in 1033 (for 8 is to be reſerved for the Square of the Figure that is to be found) which is 7 Times; this you muſt place in the Quotient, and behind the double Root, and the Work will be

472738 (687 Root
36
128) 1127
1024
1367) 10338
9569
769 remains

But if more Exactneſs be required, as to have the Root conſiſt of 6 or 7 Decimal Places, you muſt annex 12 or 14 Cyphers to the given Square, and then extract as by the foregoing Example you are directed, ſo will the Root conſiſt of whole Numbers and Decimals as followeth.

472738,00000000000000 (687,5594519 Root
36
128) 1127
1024
1367) 10338
9569
13745) 76900
68725
137505) 817500
687525
1375109) 12997500
12375981
13751184) 62151900
55004736
137511885) 714716400
687559425
1375118901) 2715697500
1375118901
13751189029) 134057859900
123760701261
Remains 10297158639

Note, That if the Number of Decimal Places in the Number given are not even, you muſt make them ſo by annexing one Cypher before you begin to extract.

EXAMPLE.

Let the Square Root of 5769,274 be required,

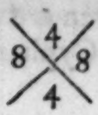
```
        Make it        5769,2740 (75,95 Root
                       49
                145)   869
                       725
               1509)   14427
                       13581
              15185)     84640
                         75925
             Remains      8715
```

To prove the Truth of this Rule.

Square the Root, or multiply it by itſelf, and if it be a juſt Square that was given, the Product will be the ſame; but if there be a Remainder, add it to the ſaid Product, and the Sum will be the given Number; ſo 75,95 ſquar'd is 5768,4025, to which add the Remainder 8715, and the Sum is 5769,2740 the Proof, this being the Number given.

Another Way to prove the Rule by the Croſs.

Caſt away the Nines out of the given Number, and place the Remainder over the Croſs, and alſo out of the Root, placing the Remainder on each Side of the Croſs, which ſquare, and to the Product add the Figures remaining after the Extraction is ended (if any) out of the Sum caſt away the Nines, and this laſt Remainder will be equal to that above the Croſs, if there be no Error in the Operation.

Thus for the laſt Example -  Proof.

The Uſe of the Square Root.

PROB. I.

To find a mean Proportional between any Two Numbers.

RULE.

Multiply one of the Numbers given by the other, and the Square Root of that Product is the mean Proportional ſought.

EXAMPLE.

What is the Mean between 46 and 62?

```
                 46
                ----
                 372
                248
                ----
                2852 (53, 40, &c.
                25
                ----
         103)    352
                 309
                ----
        1064)    4300
                 4256
                 ------
        1068)    4400
```

Anſwer 53,4.

By the foregoing Rule you'll find the Means between

$\left\{\begin{matrix}32\\ \&\\ 46\end{matrix}\right\}$ to be 38, 36, *&c.*

$\left\{\begin{matrix}82\\ \&\\ 49\end{matrix}\right\}$ to be 63, 38, *&c.*

$\left\{\begin{matrix}47\\ \&\\ 64\end{matrix}\right\}$ to be 54, 85, *&c.*

PROB. II.

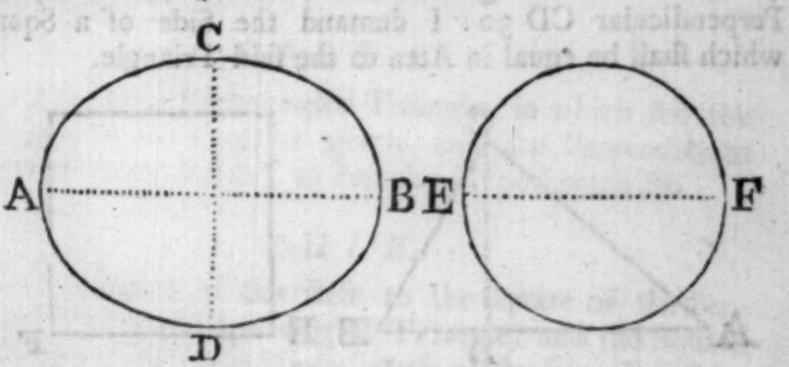
To find the Diameter of a Circle which ſhall be equal in Area to any Oval, whoſe Conjugate and tranſverſe Diameters are given.

RULE.

Multiply the Conjugate by the tranſverſe Diameter, and extract the Square Root of the Product, which Root is the Diameter of that Circle, whoſe Area is equal to that of the Oval.

EXAMPLE.

Let AB be the tranſverſe Diameter of an Oval, which let it be 46 Inches, and let CD be the Conjugate equal to 32 Inches, I demand the Diameter EF of that Circle, which ſhall be equal thereto in Area.



46
32
92
138
1472 (38,36 *facit.*
9
68) 572
544
763) 2800
2289
7666) 511,00

PROB. III.

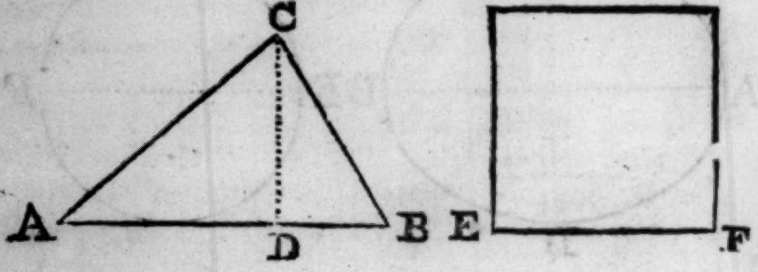
To find the Side of a Square* EF, *which ſhall be equal in Area to any given Superficies.

RULE.

Find the Area of the given Superficies, and the Square Root thereof ſhall be the Side of a Square whoſe Area ſhall be equal to that of the Superficies given, whether it be a Circle, Oval, Triangle, Parallelogram, &c.

EXAMPLE.

There is a Triangle whoſe Baſe AB is 45 Inches, and Perpendicular CD 30: I demand the Side of a Square which ſhall be equal in Area to the ſaid Triangle.



45
15 half the Perpendicular CD
225
45
675,0000 (25,97 the Side EF of the Sq.
4
45) 275
225
509) 5000
4581
5187) 41900
36309
5591 remains.

PROB. IV.

Having given (in a Right-angled Triangle) any two Sides, the third may be found by the 47th of the firſt of Euclid, *where 'tis demonſtrated that the Square of the Hypothenuſe,* viz. BC, *is equal to the Sum of the Squares of* AC *and* AB.

CASE I.

Let ABC be a Right-angled Triangle, in which AB the Baſe equal to 24 Yards is given, and the Perpendicular AC, equal to 18 Yards; to find the Hypothenuſe BC.

RULE.

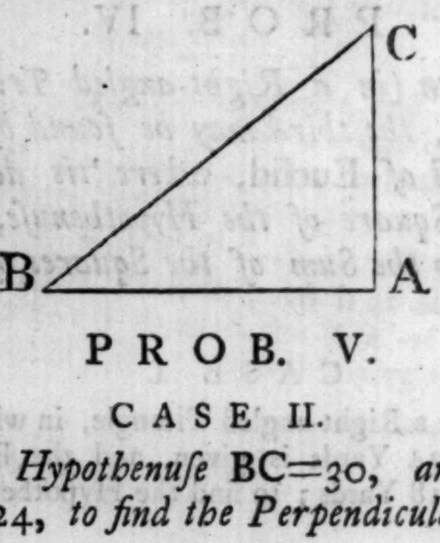
Add the Square of the Baſe to the Square of the Perpendicular (of any Right-angled Triangle) and the Square Root of that Sum is the Hypothenuſe of the ſame Triangle.

EX-

EXAMPLE.

AB the Baſe=24 AC the Perpendicular 18

```
AB the Baſe=24          AC the Perpendicular 18
             24                               18
             --                              ---
             96                              144
            48                                18
            ---                              ---
it's Square 576            it's Square       324
            324
            ---
          ) 900 (30=BC the Hypothenuſe required.
            9
            ---
         3) 000
```



PROB. V.

CASE II.

Given the Hypothenuſe BC=30, *and the Baſe* AB=24, *to find the Perpendicular* AC.

RULE.

From the Square of the Hypothenuſe ſubtract the Square of the Baſe, and the Remainder will be the Square of the Perpendicular, whoſe Square Root will be the Perpendicular itſelf.

EX-

EXAMPLE.

The Hypothenuſe 30
30
it's Square 900
576
324 (18
1
28) 224
224
0

The Baſe 24
24
96
48
576=it's Square.

Anſwer, the Perpendicular AC is 18 Yards.

PROB. VI.

CASE III.

The Hypothenuſe BC=30, *and the Perpendicular* AC=18, *given, to find the Baſe* AB.

RULE.

From the Square of the Hypothenuſe, take the Square of the Perpendicular, then the Square Root of the Remainder is the Baſe required.

EXAMPLE.

Hypothenuſe BC= 30
30
it's Square 900
Squ. of the Perp. 324
Remains 576
4 (24 Root
44) 176
176
0

Perpendicular 18
18
144
18
it's Square 324

Anſwer; 24 is the Length of the Baſe BA required.

PROB. VII.

Given the ſlanting Side of a Pyramid or Cone, and alſo the Length of a Perpendicular let fall from the Vertex to the Center of the Baſe: To find the Diameter of the Baſe.

RULE.

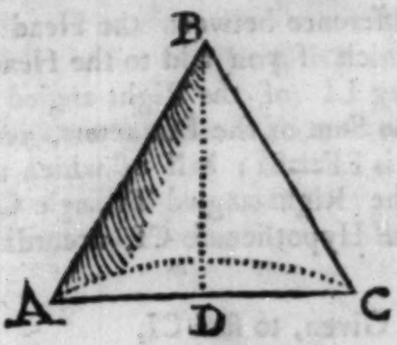
From the Square of the ſlanting Side, ſubtract the Square of the Perpendicular Line, then twice the Square Root of the Remainder is the Diameter of the Baſe required.

EXAMPLE.

Let the ſlanting Side be AB=60; which (becauſe ABD is a Right-angled Triangle) may be called the Hypothenuſe; and let the Perpendicular given be BD=48, to find AD=½ AC.

BD=48
AB=60 48
60 384
192
it's Square 3600
BD's Squ. 2304 and 2304 is it's Square.
Rem.) 1296 (36 Root=AD=½ AC.
9 therefore AC=72 required.
66) 396
396
0

PROB.



PROB. VIII.

Given the Bung and Head Diameters (of a Cask, &c.) and alſo the Length, to find the Diagonal Line.

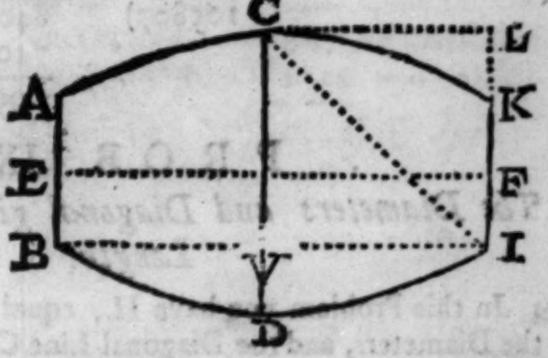
RULE.

To the Square of Half the Sum of the Diameters, add the Square of Half the Length, then the Square Root of the Sum is the Diagonal Line required.

EXAMPLE.

Let the Head Diameter be AB=IK=42 Inches, the Bung Diameter CD=49 Inches, and the Length EF=BI =54; What is the Diagonal Line CI?

Note, That = ſignifies Equal to, and + ſignifies to Add or More.



The half Difference between the Head KI, and Bung CD, is LK, which if you add to the Head KI, the Sum will be the Leg LI (of the Right-angled Triangle CLI) equal to half the Sum of the Diameters, *viz.* CD+KI.

The Length is EF=BI; half of which is VI=CL, the other Leg of the Right-angled Triangle CLI: By which you may find the Hypothenuſe CI, according to the Caſe of *Prob.* 4.

LI=45.5 }
CL=27. } Given, to find CI.

CL=27
27
189
54
CL □ 729

LI=45.5
45.5
2275
2275
1820
2070.25 LI □
729.
2799.25 (52.907 CI.
25
102) 299
204
1049) 9525
9441
105807) 840000
740649
.99351

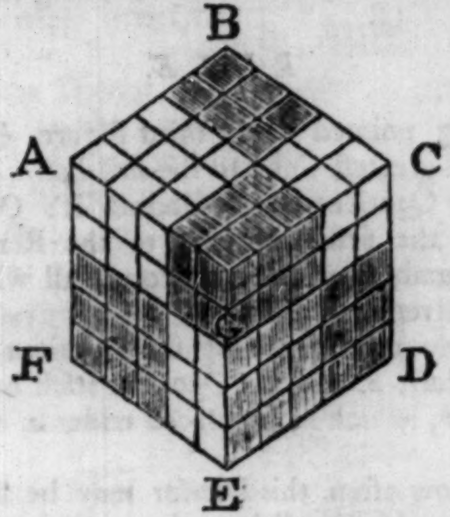
P R O B. IX.

The Diameters and Diagonal given, to find the Length.

In this Problem you have IL, equal to half the Sum of the Diameters, and the Diagonal Line CI: to find CL, which will be equal to VI=½ the Length BI required, and may be found by *Prob.* 5 or 6 foregoing.

To extract the Cube Root.

NOTE, that a Cube is a ſolid Body, contained under ſix equal Squares, as the Figure ABCDEFG.



A Cube Number is that which is made by multiplying any Number into itſelf, and that Product again by the Number given, and this laſt Product is the Cube of the Number ſo involved: So 125, 216, and 343 are the Cubes of 5, 6, and 7 produced as above. Thus,

$$\begin{array}{lccc} \text{Roots} & 5 & 6 & 7 \\ & \underline{5} & \underline{6} & \underline{7} \\ \text{Squares} & 25 & 36 & 49 \\ & \underline{5} & \underline{6} & \underline{7} \\ \text{Cubes} & 125 & 216 & 343 \end{array}$$

By this you may know, that the Product of any Number into itſelf is called the Square of that Number; which

Square, being multiplied by it's Root, produceth the Cube, or third Power of the ſame Number, *&c.* as you may ſee by the Table of Powers.

To know of how many Figures the Root of any Cube doth conſiſt, you muſt make a Point over every third Figure, beginning with the Place of Units, and ſo many Points as you make, ſo many Figures you muſt expect in the Root, which may be found according to the following

RULE.

1. Having pointed every third Figure, *&c.* as above, find the next greateſt Cube to the firſt Point, then place it's Root in the Quotient, and ſubtract it's Cube from the Numbers of the firſt Point, and to the Remainder bring down the Numbers of the next Point, all which you may call the Reſolvend.

2. Multiply the Square of the Quotient by 300, and call the Product, *a*, and the Quotient itſelf by 30, and call the Product *b*, which being placed under *a*, their Sum is a Diviſor.

3. Find how often this Diviſor may be had in the Reſolvend, upon this Condition, that when you multiply *a*, by the Number thus found, and *b* by it's Square, and the Cube thereof added to the two Products, the Sum may be either equal to the Reſolvend, or next neareſt under it; if leſs, ſubtract it from the Reſolvend, and to the Remainder bring down the Figures of the next Period.

4. Multiply the Square of the new Quotient by 300, and call the Product *a*, and the Quotient itſelf by 30, and call the Product *b*, as before; then add theſe Products together for a Diviſor, with which work as before, and ſo on from Period to Period, until you have found the Root of the Number given.

E X-

EXAMPLE.

What's the Cube Root of - - - - - 12812904 (234

The greateſt Cube to the firſt Point (ſubtract) 8

The Remainder is 4, to which bring down 812, and the Reſolvend is - - - } 4812

The Square of the Quotient multiplied by 300 is - - - } 1200=*a*

The Quotient itſelf multiplied by 30 is - - - - - - } 60=*b*

Their Sum is the Diviſor - - 1260

I find that this, on the Conditions above, may be had thrice in the Reſolvend; then *a*=1200 × 3=3600

and *b*= 60 × 9= 540

and the Cube of 3 is - = 27

The Sum of theſe three is (ſubtract) - - 4167

To the Remainder 645 bring down 904, and it makes - - - - - - - - } 645904

The Square of the new Quotient multiplied by 300, is - - - - 158700=*a*

And the Quotient itſelf, *viz.* 23 × 30 is - - - } 690=*b*

Their Sum is a Diviſor - - 159390

This may be had 4 Times in the Reſolvend - } 645904

Then - - *a*=158700 × 4= - 634800

and - - *b*= 690 × 16= - 11040

To theſe add the Cube of 4= - 64

The Sum of theſe three is - - - 645904

Which being taken from the laſt Reſolvend - 645904

The Remainder is - - - - - 0

Hence we find that 12812904 was a true Cube Number, and that it's Root is 234. But if any Thing had remained, you muſt have annex'd 3 Cyphers to it, and then proceed to find the next Figure to put in the Quotient, as before. Where note, That, for every three Cyphers which you make Uſe of this Way, you will have one Decimal Place in the Root. But, before you begin to extract the Cube Root of any whole Number, you may ſet 3, 6, 9, or 12 Cyphers on the Right Side of it, and point all, as before, and then proceed to find the Root, as you ſee in the Example following.

Let it be required to find the Cube Root of 427362.

```
.  .   .  .  .  .
427362,000000000000 (75,3237 Root
343
 84362
 78875
  5487000
  5082777
   404223000
   340295768
    63927232000
    51059955267
    12867276733000
    11914574816053
      952701916947 remains
```

If the Number given, to have it's Cube Root extracted, has any Number of Decimal Places, that are not 3, 6, 9, 12, *&c.* you muſt make them to conſiſt of 3, 6, 9, or 12 Places, as you ſee Occaſion, by placing Cyphers on the Right Hand, and then point as if all were whole Numbers.

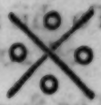
To prove the Truth of the Work,

You muſt add what remains to the Cube of the Root; if the Sum be the given Number, the Work is right, elſe not; but when the Root conſiſts of many Figures, this Way may be thought tedious, therefore the following Method will be more ſhort.

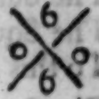
Proof by the Croſs.

Caſt away Nines out of the given Number, and ſet the Remainder over the Croſs, and alſo out of the Root, and place the Remainder on either Side of the Croſs; which ſquare, and caſt away the Nines out of the Product, ſetting the Remainder on the other Side of the Croſs; then multiply theſe two Remainders together, and to the Product add the Figures remaining after the Extraction is finiſhed, (if any) out of the Sum caſt away the Nines, and this laſt Remainder will be equal to that over the Croſs, if the Work be true.

According to this the Proof of the firſt Example is



And the Proof of the laſt is - - -



Another and more expeditious Way to extract the Cube Root.

RULE.

1. Having pointed the given Number, as before, take the Difference between it and the next neareſt Cube to the firſt Point, whether it be more or leſs than juſt, and place the aſſumed, or ſuppoſed, Root in the Quotient, with as many Cyphers after it as there are remaining Points, which multiply by 3, and divide the ſaid Difference by the Product.

2. To the Quotient add one fourth Part of the Square of the ſuppoſed Root, if it be leſs than juſt; but if more

than juſt, then take the Quotient from that fourth Part, and extract the Square Root of the Sum, or Remainder, and thereto add half the ſuppoſed Root, and the Sum will be the Cube Root required, or near it: Which being found, cube it, and if it is the ſame with the given Cube, or ſufficiently near it, at the firſt Operation, you have done; if not, take the Difference between the Cube of this new Root, and the given Number; and proceed with this Difference and new Root for a ſecond Operation, as you did for the firſt.

EXAMPLE I.

Let it be required to find the Cube Root of	12812904 (200
The firſt ſuppoſed Root is 200 (leſs than juſt) it's Cube - - -	8
Remainder, or Difference, is - -	4812904
This divided by 600=200 × 3, the Quotient is	8021
To this add the fourth Part of the Square of 200 - - - -	10000
The Sum is - - - -	18021
The Square Root of which is - - -	134
To this add half the ſuppoſed Root - -	100
The Sum is the Cube Root required= - -	234

EXAMPLE II. 8

What's the Cube Root of - - -	6644672 (200
The firſt ſuppoſed Root is 2 (and more than juſt) it's Cube is 8, and Difference	1355328
Divide this by thrice the ſuppoſed Root= 600, the Quotient is - - - -	2258,88
Subtract this from the fourth Part of the Square of 200, *viz.*	10000,
Remains - - - - -	7741,12
The Square Root of this is - - -	88,
To this add half the ſuppoſed Root - -	100,
The Sum is the Cube Root required - -	188,

Note, That at the firſt Example, the Quotient was added to the fourth Part of the Square of the aſſumed Root, becauſe it was taken leſs than juſt; but at the ſecond Example, the Quotient was ſubtracted from the fourth Part of the Square of the aſſumed Root, becauſe it was taken more than juſt.

EXAMPLE III.

What's the Cube Root of - - 427362 (70,
The firſt ſuppoſed Root is 7 (leſs than juſt)
it's Cube is - - - } 343
Remainder, or Difference, is - - 84362,
This Dividend by 70 × 3 = 210, the Quotient is 401,7238
To this add the fourth Part of the Square of 70 = 1225,
The Sum is - - - - - 1626,7238
The Square Root of this is - - 40,33
To this add half the aſſumed Root (*viz.* of 70) 35,
Sum is - - 75,33

This Sum is the firſt aſſumed Root, correct or brought nearer the true Root, but for a ſecond Operation we will take only 75,3 for the new Root.

The Number given was - - - 427362, (75,3
The Cube of the new Root 75,3 is
(ſubtract) - - - } 426957,777
The Difference is - - - 404,223
This divided by thrice 75,3 = 225,9,
the Quotient is - - } 1,789389
To this add the fourth Part of the
Square of 75,3 = - - } 1417,5225
The Sum is - - - 1419,311889
The Square Root of this is - 37,67376924, &c.
To this add half the aſſumed
Root, *viz.* half 75,3 = - } 37,65
The Sum is the Cube Root required 75,32376924

In like manner you will find the Cube Root of 2 to be } 1,259921049895
The Cube Root of the Wine Diviſor 231 to be - } 6,13579243966195897
Of 93759,57507 to be - - 45,42
And of 401719179 to be - ,737

The Uſe of the Cube Root.

PROB. I.

The Diameter and Weight of a Bullet given, to find the Weight of another Bullet, whoſe Diameter is alſo given.

This is anſwered from the *Prop.* 18. of the 12th Book of *Euclid*; from whence may be drawn the Proportion following, *i. e.*

As the Cube of the Diameter of the given Sphere or Bullet is to the Cube of the Diameter of any other Sphere or Bullet, ſo is the Weight of that given Bullet, *&c.* to the Weight of the other required.

EXAMPLE.

There is a Bullet whoſe Diameter is 4 Inches, and it's Weight 9 Pounds: I demand the Weight of another Bullet, whoſe Diameter is 7,5 Inches.
the Cube of 4 is 64
and the Cube of 7,5 is 421,875

Then ſay as 64 : 421,875 : : 9 *l.* : 59,3261 *l.* thus,

```
        421,875
              9
     ----------
64) 3796,875 (59,326 Anſwer
    320
    ----
     596
     576
     ----
      208
      192
      ----
       167
       128
       ----
        395
        384
        ----
         11
```

PROB. II.

There is a Conical Tun, whoſe Top Diameter is 30 }
Bottom Diam. 40 } Inches
and Depth 20 }
And the Content in Beer Gallons - - 68,7
I would know the Diameters and Depth of another Conical Tun, that will hold 90 Beer Gallons?

Becauſe ſimilar, or like Solids, are to one another as the Cubes of their like Sides, ſay, as the Content of the given Tun - - - - - 68,7 Gall.
Is to the Cube of it's Top Diameter, *viz.* 30 = 27000,
So is the Content of the other Tun - - - 90 Gall.
To the Cube of it's Top Diameter - 35371,179
The Cube Root of which is the Top Diameter = 32,82 Inches.

Having

Having thus found the Diameter at the Top, you may find the Diameter at the Bottom and the Depth, by the Rule of Three Direct. Thus,

As the Top Diameter of the given Tun	30,	Inches
Is to the Top Diameter of the other Tun	32,82	
So is the Bottom Diameter of the given Tun	40,	
To the Bottom Diameter of the other Tun	43,76	

Again for the Depth ſay,

As the Top Diameter of the given Tun -	30,	Inches
Is to the Top Diameter of the other Tun -	32,82	
So is the Depth of the given Tun - -	20,	
To the Depth of the other Tun -	21,88	

Hence the Dimenſions of the other Tun are,

Diameter at the Top - -	32,82	Inches
Diameter at the Bottom -	43,76	
Depth - -	21,88	

To prove the Truth of theſe Numbers you will find the Content of the Tun in Beer Gallons to be - - - 89,963

which wants but ,037 of a Gallon of the Content deſired.

To calculate Diagonal Tables or Lines for Casks, taken as the middle Fruſtum of a Spheroid.

By *Prob.* 8. of the Square Root find the Diagonal thus; let the Bung Diameter be 26 Inches, the Head 20, and Length 24: What's the Content and Diagonal?

Bung

```
     Bung 26                 Length 24
     Head 20            ½ the Length 12
          ——                         ——
      Sum 46                         12
½ the Sum 23            it's Square 144
          23
          ——
           69
          46
          ———
it's Square 529
            144
          ————
          673,00 (25,94 Diagonal of the Caſk.
          4
          ———
     45)  273
          225
          ————
    509)   4800
           4581
           —————
   5184)   21900
           20736
           —————
            1164
```

The Content of the Veſſel is 39 Beer Gallons.

Having by the Bung, Head, and Length, above given, found theſe two Requiſites, *viz.* the Content of the Caſk and it's Diagonal, you may find the Diagonal Line of any other Caſk, whoſe Content is given by the Proportion following, *viz.* as 39 is to 17454,6 (the Cube of the Diagonal 25,94) ſo is 1, 2, 3, 4, 5, 6, 7, *&c.* the Contents of another Spheroidal Caſk, to the Cube of their Diagonals, whoſe Cube Roots will be the Diagonals for the Contents given; which you may collect into a Table or project upon an Inſtrument, as Occaſion requires. But here note, that though I ſhall give one Example here, and perform it according to Decimal Arithmetick, for Order's Sake, yet this Sort of Work may be beſt managed by the Logarithms, as

You may ſee in Mr *Marmaduke Hodgeſon*'s Book of Gauging, *Page* 67, 68.

EXAMPLE.

Let it be required to find the Length of the Diagonal Line of that ſpheroidal Caſk, whoſe Content is 20 Gallons.

Say, as 39, the Content of a ſpheroidal Caſk, is to the Cube of it's Diagonal Line, 17454,6; ſo is 20, the Content of another ſuch Caſk, to 8951, the Cube of it's Diagonal, whoſe Cube Root is, 20,7 the Anſwer.

By this you may know, that if you let fall a Rule (having only a Line of Inches on it) Diagonal-wiſe from the Bung, and find that the Length of that Line is 20,7 Inches, that the Content of that Caſk is 20 Beer Gallons.

This may be better underſtood, and done with much more Expedition, when I come to ſpeak of the Sliding-Rule. And here note, That to find the Side of a Cube which ſhall be equal in Content to any given Solid, is only to extract the Cube Root of the Content of that Solid, whether it be a Cone, Sphere, or Cylinder, *&c.*

The Rule of *THREE.*

I Need not go about to define this Rule, ſince the very Name is a ſufficient Definition: However, ſome Queſtions proper to it are as follow.

PROB.

PROB. I.

C. *l.* *s.* *l.*
If 42 coſt 172 : 16 : what will 47 coſt?
112 172,8 in a Decimal Way.
224 47
448 12096
4704 6912

4704) 8121,6000 (1,7265, *i. e.* by Reduction.
4704
l. *s.* *d.* *q.*
34176 1 : 14 : 6 : 1,44 the Anſwer.
32928
12480
9408
30720
28224
24960
23520
1440

If the Duty of 16 Buſhels of Malt be 8 Shillings, what is the Duty of 732 at that Rate?

B. *l.* *B.*
If 16 : ,4 : : 732
,4
l. *l.* *s.* *d.*
16) 292,8 (18,3 *i. e.* 18 : 6 : 00 for Anſwer.
134(0
00

If the Duty of 32 Barrels of X Beer be worth
l. s.
7 : : 12. what's the Duty of 72,56 Barrels?

B. l. s. l. B.
If 32 give 7 : 12, *i. e.* 7,6 ; what will 72,56 give?
7,6

43536
50792

32) 551,456 (17,233
23709(0
010(0

l. s. d. q. l.
Anſ. 17,233 ; which by Reduction is 17 : 4 : 7 3, 68

If the Salary of an Officer be 48,5 *per Annum*, what muſt be paid him for 232 Days?

d. l.
If 365 give 48,5 ; what will 232 Days?
232

970
1455
970

365) 11252,300 (30,827, Anſwer, *i. e.*
1095

3020 l. s. d. q.
2920 30 : 16 : 6 : 1,92

1000
730

2700
2555
145

If the Duty of 172 Buſhels of Malt be

l. *s.* *l.*

4 : 6. *i. e.* 4,3 ; what will the Duty of 92 Buſhels be?

B. *l.* *B.*

If 172 give 4,3 ; what will 92 give?

92

86

387

l. *l.* *s.*

172) 395,6 (2,3. *i. e.* 2 : 6. for Anſwer.

344,

516

516

0

l. *s.* *l.*

If the Duty of 92 Buſhels of Malt be 2 : 6. *i. e.* 2,3 ; what is the Duty of 172 Buſhels?

B. *l.* *B.*

If 92 give 2,3 ; what will 172 give?

2,3

516

344

l. *s.*

92) 395,6 (4,3 Anſ. *i. e.* 4 : 06 :

27(0

(0

If the Intereſt of 100 Pounds be 5 *l.* *per Annum* ; what may I demand for the Uſe of 45 *l.* : 18 *s.* : *i. e.* 45,9 *l.* for one Year at that Rate?

If

l. *Int.* *l.*
If 100 give 5; what 45,9
5
l. *l.* *s.* *d* *q.*
100) 229,5 (2,295, *i. e.* 2 : 05 : 10 : 3,2
l. *s.* *d.* *q.*
Anſwer 2 : 05 : 10 : 3,2

Having the Diameters and Depth of a Conical Tun; to find the Depth or Heighth of the whole Cone, of which ſuch a Tun is a Fruſtum.

EXAMPLE.

Let ABCD be the Fruſtum of a Cone, and let the Diameter at the Baſe AB be 40 Inches; that at the Top CD=35. and let the Depth OP be 27: I demand the Heighth of a Cone, *viz.* ON, the Diſtance of the Vertex N, from the Center of the Baſe O.

RULE.

Say, as Half the Difference of the Diameters DC, and AB, *i. e.* A*d* or B*c* is to the Depth of the Fruſtum *c d* or D*c*: So is Half the Diameter of the Baſe AB, *i. e.* AO=BO, to the Heighth of the whole Cone NO.

	in.
Greateſt Diameter	40
Leaſt Diameter	35
Difference	5
Half the Difference	2,5

Half the Baſe AB is 20; then ſay,

A*d* : C*d* : : AO : NO.
As 2,5 : 27 : : 20 : 216.
20

2,5) 540,0 (216, Anſwer, *i. e.* NO the Heighth re-(quired.
045(0
1(0

Here you may note, that the Triangles ANO, and AC*d*, are ſimilar, and therefore the Proportion preceding is grounded upon *Prop*. 4th of *Euclid* 6, where 'tis demonſtrated, that the Sides of Equiangular Triangles are Proportional.

Having the Heighth of a Cone, and the Diameter of it's Baſe, to find the Diameter at any Depth.

The Solution of this *Problem* depends upon the ſame Geometrical Principle with the laſt; and conſequently may have the ſame Figure to inform the Mind.

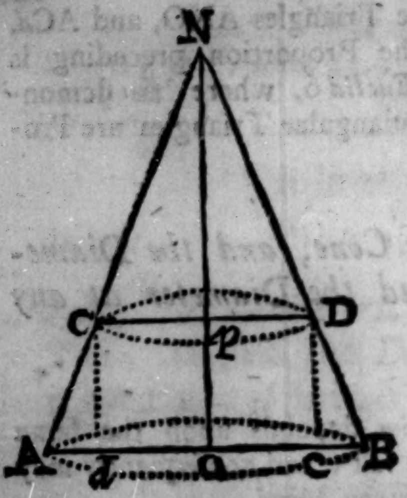
EXAMPLE.

Let the Heighth be NO=216 Inches, and the Diameter AB=40; to find the Diameter CD at 27 Inches from the Baſe AB.

1. Take 27=*c d*=*p o*, out of NO=216, and there will remain 189, the Side N*p* of the right-angled Triangle NC*p*.

2. Say, as the Side NO=216, is to half the Diameter AO=20, ſo is N*p*=189, to C*p*=17,5, which is half the Diameter CD; which double gives 35=CD, the Diameter required.

By the laſt Example you may find the Diameter at every 5 or 10 Inches Depth of any Conical Tun; and this will be of great Uſe in the Practice of Gauging.



$NO = 216$
$CD = 35$
$AB = 40$
$Ad = Bc = 2{,}5$
$Cd = Dc = po = 27$
$Np = 189.$

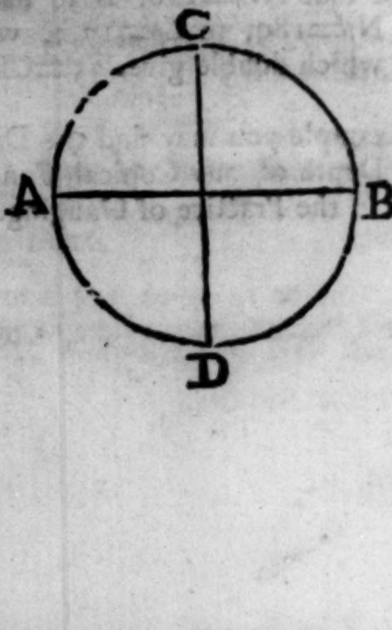
Having the Diameter of a Circle to find it's Circumference.

RULE.

Say, as 1 is to 3,1416, or as 113 to 355, or as 7 is to 22; ſo is the Diameter to the Circumference.

EXAMPLE.

Let the Diameter AB of the Circle ABCD be 32 Inches, what's the Circumference?



1. As 1 : 3,1416 : : 32
32
62832
94248
Facit 100,5312, by the firſt Way.

2. As 113 : 355 : : 32
32
710
1065
113) 11360,0000 (100,5309, by the ſecond Way.
00060510(3
006311(8
0001(0

3. As 7 : 22 : : 32
22
64
64
7) 704,0000 (100,5714, by the third Way.
004513(2

This laſt Way I would recommend, being eaſy to remember, yet not ſo exact as either of the other, but near enough for indifferent Uſes.

Having the Circumference of any Circle to find the Diameter.

Say, as 3,1416 is to 1, or as 355 is to 113, or as 22 is to 7, ſo is the Circumference of any Circle to it's Diameter.

E X-

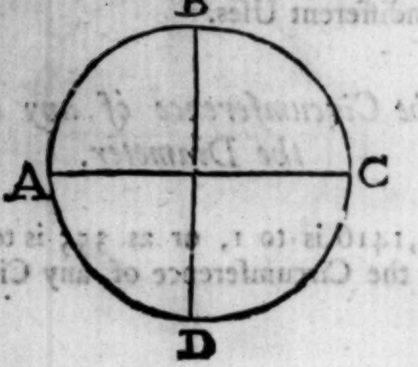
EXAMPLE.

Let the Circumference be 97 Inches, what's the Diameter?

1. As 3,1416 : 1 : : 97
3,1416) 97,0000000 (30,875 Diameter required, firſt Way.
02752028(0
275270(0
2388(0
18(1
(3

2. As 355 : 113 : : 97
97
791
1017
355) 10961,000 (30,876 Diameter, the ſecond Way.
031105(0
3171(2
22(0

3. As 22 : 7 : : 97
7
22) 679,000 (30,863 Diameter, the 3d Way.
01948(4
110(1



To find the Duty of any Number of Buſhels of Malt, ſuppoſing 'twas given in the Groſs.

RULE.

Multiply the Number of Groſs Buſhels by ,02; and the Product will be the Pounds or Decimal Parts of a Pound Sterling; which is the Duty thereof.

EXAMPLE.

What's the Duty of 437,5 Buſhels of Malt Groſs?
,02
——— *l.* *s.* *d.*
Anſwer 8,750, *i.e.* 8 : 11 : 00

Having the Duty of any Number of Buſhels Neat, and the Groſs alſo, you may find the former Multiplicator by aſking the Queſtion following, *viz.*

What Number is that by which if you multiply the Groſs, the Product ſhall be the Duty?

By this you know, that if you divide the Duty of the Neat in Pounds or Parts by the Groſs, the Quotient will be ,02 a common Multiplicator in this Caſe.

EXAMPLE.

Let the Groſs be 20 Buſhels, the Neat 16, and the Duty 8 Shillings; that is, ,4 of a Pound Sterling, which divide by 20, the Groſs 20) ,40 (,02 is the Multiplicator.
(0(0

The Uſe of the Sliding Rule.

The ingenious Mr *Everard* has ſufficiently handled this Subject, therefore I might have ſaved myſelf that Trouble; but becauſe 'twill be expected, and the Book more uſeful, I ſhall ſay ſomething to that Purpoſe, and begin firſt with

NUMERATION upon the Lines.

Numeration by theſe Lines may be underſtood by this one Thought, *viz.* That what Denomination ſoever the 1 at the Beginning of the Line is, that in the Middle will be ten Times, and that at the End will repreſent an hundred Times ſo many; which, if underſtood, 'tis not hard to know what the intermediate Figures and Parts are.

EXAMPLE I.

To find the Place of 25, you may call the 1 at the Beginning of the Line but 1, then will that in the Middle be 10, and the 2 which ſtands upon the ſecond *Radius,* will be 20; then count five of the grand Diviſions; where ſtop, for that is the Place which repreſents 25. Where note, that if you had eſteemed the 1 at the Beginning of the Line but ,1 that is, one Tenth, the Place which now repreſents 25, would then ſignify but 2,5; alſo, if you had eſteemed it as 10, then would the Place of 25, be 250; if 100, then 2500; if but ,01, then but ,25, *&c.*

EXAMPLE II.

Find, upon the Line A or B, the Place of 3652.

Firſt, eſteem the 1 at the Beginning of either Line to be 100, then will that on the Middle be 1000, and the 3, which is on the ſecond *Radius* is 3000; from which count 6 of the grand Diviſions and a Half (towards 4000) and then you'll come to the Place of 3650. Now you muſt imagine the 2 to be a little beyond that half Diviſion; (for in this and the like Examples, where we are to find 4 Places, that which is in the Place of Units muſt be taken by Eſtimation) ſo have you the Place of 3652.

EXAMPLE III.

Find upon the ſame Lines the Place of 15737.

Firſt eſteem the 1 at the Beginning of the Line to be 1000, then will that in the Middle be 10000, and 5 of the grand Diviſions will be 5000, *i. e.* 15000; then is 3 and Half of the intermediate Diviſions the Place of 700, *i. e.* 15700: And as for the Place of 37, you muſt by Eſtimation take it a little farther forward. So will you come to the Places 15737: But here you are to note, That you can't exactly find the Place of any Number which exceeds 4 Places; and in many Caſes you will not be ſure of the 4th Place. However, what has been ſaid is ſufficient to explain Numeration.

MULTIPLICATION by the Lines.

This Rule (whether to be performed Arithmetically or Inſtrumentally) depends upon *Euclid*'s *Elements*, *Prop.* 1. *Lib.* 2; where 'tis demonſtrated, that if two Lines be propoſed, whereof one is divided into diverſe Parts, the Rectangle contained under thoſe two Lines, is equal to the Rectangles contained under the Line which is not divided, and the Parts of the Line divided.

The Proportion is, as 1 is to the Multiplier, ſo is the Multiplicand to the Product.

EXAMPLE I.

Let it be required to multiply 26 by 9.

RULE.

Set 1 (upon the Line B) to 9 upon A; then againſt 26 upon B, is 234, the Product ſought upon A. Where note, that when the Product conſiſts of three Places, the Rule will inform you what two Figures ſhould poſſeſs the Places of Tens and Hundreds, but what ſhould poſſeſs the Place of Units will ſometimes be doubtful; therefore, that they may be always certain what that Figure ſhould be, you may in your Mind multiply the Unit Figure of the Multiplier by that of the Multiplicand, as above. I multiply 6 by 9, and the Product is 54; by which I know the 4 will poſſeſs the Units Place of the Product.

EXAMPLE II.

Let it be required to find the Product of 72 in 26.

RULE.

Set 1 upon B, to 26 upon A; then againſt 72 on B is 1872 upon A; and ſuch is the Rectangle of 26 in 72.

It ſometimes ſeems doubtful how many Figures ſhould be in the Product; to remedy which take the Rule following.

RULE.

Obſerve how many Figures above Units are in the Multiplicand, and how many in the Multiplier; then for every one as there is in both, (above Units) reckon one in the Product; and for the Units in both, reckon one more. And laſtly, if the Multiplicand is found againſt the Product in the ſame *Radius* on which the Multiplier was, you'll have no more Places than you had by your former Account. But if it falleth beyond that *Radius*, you muſt account (for that) one Place more; as in the laſt Example, for the 2, I reckon 1, and for the 7, 1, *i. e.* 2. then the 2 in 72, and 6 in 26, are both in the Place of Units, for which I reckon one more, *i. e.* 3; then when my Rule is ſet, *i. e.* when I ſet 1 on B, to 26 on the firſt *Radius* of the Line A, I find 72 upon B will not fall upon the ſame *Radius*, on which 26 is, but the next beyond; for which I reckon another Place in the Product, which add to the 3 as before found, and the Sum, *viz.* 4, will inform me, that the Product will conſiſt of 4 Places, *viz.* 1872, as above.

DIVISION by the Lines.

In Diviſion, the Quotient contains Unity as often as the Dividend does the Diviſor: It follows then from the 5th Definition to the 5th Book of *Euclid*'s *Elements*, that the Quotient is in Proportion to 1, as the Dividend is to the Diviſor; from whence then we may alſo deduce the Proportion following, *viz.* as the Diviſor is to 1, ſo is the Dividend to the Quotient.

EXAMPLE I.

Divide 336 by 12.

RULE.

Set 12 upon B, to 1 upon A; then againſt 336 upon B, you'll find 28 upon A; which is the Quotient required.

You'll know how many Figures ſhould be in the Quotient, by ſetting the Diviſor orderly under the Dividend, *&c.*

EXAMPLE II.

Divide 48627 by 96.

RULE.

Set 96 upon B, to 1 upon A; then againſt 48627 on B, you have 506,53 the Quotient required upon A. So

$$\text{if}\left\{\begin{matrix}26\\48\\96\end{matrix}\right\}\begin{matrix}\text{were given to be divi-}\\\text{ded by 6, you'll find}\\\text{the Quotient to be}\end{matrix}\left\{\begin{matrix}4.33,\ \&c.\\8.\\16.\end{matrix}\right.$$

REDUCTION *of Decimals by the Rule.*

Let this Vulgar Fraction, *viz.* $\frac{3}{4}$, be given to be reduced into a Decimal.

RULE.

As the Denominator 4 is to it's Numerator 3, ſo is 1,00 the Decimal Denominator to ,75 the Decimal Numerator: Which is the Decimal of $\frac{3}{4}$: *Where note,* That every Decimal will be as little in Reſpect of 1, as the Numerator is in Reſpect of the Denominator of it's Vulgar Fraction. Set 4 upon B, to 1 upon A; then againſt 3 upon B, is ,75 on A; and that is the Decimal of $\frac{3}{4}$: For as 3 the Numerator is to 4 it's Denominator, ſo is ,75 a Decimal Numerator to 100, it's Denominator, *&c.*

EXAMPLE II.

What's the Decimal of 18 Shillings, making a Pound Sterling the Integer?

The Vulgar Fraction is $\frac{18}{20}$; therefore ſet 20 upon B, to 1 upon the Line A; then againſt 18 on B, is ,9 on A; which is the Decimal required.

EXAMPLE III.

What Decimal Part of a Barrel is 12 Gallons? The Vulgar Fraction is $\frac{12}{34}$; therefore ſet 34 upon B, to 1 upon A; then againſt 12 on B, is ,35, *&c.* on A; which is the Decimal of 12 Gallons required.

To find the Value of the Decimal of a Pound Sterling.

EXAMPLE I.

What is the Value of ,27 of a Pound Sterling?

1. Set 1 upon B, to 20 upon A; then againſt ,27 on B, is 5,4 on A, *i. e.* 5 Shillings, 4 Tenths.

2. Set 1 upon B, to 12 upon A; and then againſt 4 on B, you'll find 4,8 on A, *i. e.* 4 Pence, and 8 Tenths of a Penny.

3. Set 1 upon B, to 4 upon A; then againſt 8 on B is 3,2 on A, *i. e.* 3 Farthings, and ,2 of a Farthing. And thus by the Rule you find, that the Value of ,27 of a Pound Sterling is 5 Shillings 4 Pence 3 Farthings, and ,2 of another.

EXAMPLE II.

What is the Value of ,62 of a Barrel of Beer?

1. Set 1 upon B, to ,62 upon A; then againſt 4 upon B, is 248 on A, from which (according to Multiplication) cut off two Places, and then 'tis 2,48, *i. e.* 2 Firkins, and ,48 Parts.

2. Set 1 upon B, to ,48 on A; then againſt 8,5 on B, is 4080 on A, from which cut off three Places, and then 'twill be 4,080, *i. e.* 4 Gallons and ,080 of a Gallon.

F. Gall.

So the Value of ,62 of a Barrel of Beer is 2 : 4 : 08.

And according to this Method may the Value of any Decimal be found, either in Weight, Meaſure, Money, or Time, to a very inconſiderable Matter.

The Rule of THREE by the Lines.

The Rule of Three by the Lines muſt be performed by the Method following: *viz.*

Set the firſt Number on B, to the ſecond on A; then againſt the third Number on the Line B, you'll have the fourth required on A.

EX-

EXAMPLE I.

If the Duty of 16 Buſhels of Malt be 8 Shillings, what's the Duty of 47 Buſhels at that Rate?

OPERATION.

Set 16 upon B, to 8 upon A; then againſt 47 on B, you'll find 23,5 on A, *i. e.* 23 Shillings 6 Pence, the Anſwer.

EXAMPLE II.

If the Proportion to find the Circumference of a Circle be as 113 to 355, I demand the Circumference of a Circle, whoſe Diameter is 26?

OPERATION.

Set 113 upon B, to 355 upon A; then againſt any Diameter on B, you'll have it's Circumference on A: So againſt 26 on B, you have 81,68 on A, the Circumference required.

EXAMPLE III.

Having the Circumference of a Circle to find the Diameter, the Proportion is as 355 to 113; ſo is any Circumference to it's Diameter.

Let the Circumference be 96, what's the Diameter?

OPERATION.

Set 355 upon B, to 113 on A; then againſt any Circumference upon the Line B, you'll have it's Diameter on A; ſo againſt 96 on B, you'll find 30,5 on A, the Diameter required. There is a Braſs Point ſet in the Line B, at 3,14159 the Circumference of a Circle whoſe Diameter is 1, the Uſe of which is, that if you ſet this Point to 1 upon the Line A, then againſt any Circumference upon B, you will have it's Diameter upon A; and, as the Rule ſtands, find any Diameter upon the Line A, and againſt that, you will find the Circumference upon the Line B.

EXAMPLE IV.

The Proportion between Beer and Wine is as 9 to 11. Suppoſe by the following Rules, that I found a Veſſel to contain 42 Gallons of Beer; I demand how many Gallons of Wine the ſame will hold?

OPERATION.

Set 9 upon B, to 11 upon A; then againſt 42 on B, you'll find 51,33, *i. e.* 51 Gallons, ,33 Parts of Wine on A, the Anſwer.

To find the Area of a Circle in Beer and Wine Gallons, and Malt Buſhels.

RULE.

Say, as the Gauge Point (proper to that Denomination in which you'll find the Area) on the Line D, is to 1 on C; ſo is any Diameter on D, to it's Area on C.

EXAMPLE.

There is a Circle, whoſe Diameter is 56 Inches; what is the Area in Beer and Wine Gallons, and Malt Buſhels?

For Beer, ſet the Gauge Point, *viz.* 18,95 marked with AG, on the Line D, to 1 on C; then againſt 56 on D, you'll find 8,73 on C, and, as the Rule is now ſet, it may ſerve as a Table of Circles Areas; for againſt any Diameter on D, you'll find it's Area on C.

For Wine, ſet the Gauge Point, *viz.* 17,15, (marked with WG) on the Line D, to 1 on C; then againſt 56 on D, you'll find 10,666 on C, the Area required.

For Malt, ſet the Gauge Point, *viz.* 52,32 (marked with MB) on D, to 1 on C; then againſt 56 on D, you'll find 1,145, on C, the Area required. Here note, that if you'd have $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, $\frac{3}{4}$, *&c.* of the Area of a Circle, you muſt ſet the Gauge Point, to $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, $\frac{3}{4}$, *&c.* of 1, and then againſt the Diameter you'll find the like Part of it's Area.

Beſides the ſeveral Lines upon the Outſides of the Sliding Rule, there are others upon the Inſide of the Sliders, by which the Areas of Circles may be readily found by Inſpection, as far as 36 Inches Diameter.

Thus, the Body of the Rule being 12 Inches, and ſuppoſe the Diameter of a Circle juſt as long, the Area will be ,4 of an Ale Gallon. Now if you ſet 10 upon B to 10 upon A, and 1, upon the Slip C, to the End of the Body of the Rule next the Left Hand; then the Body of the Rule and Ends of the two Slips will be 13 Inches, againſt which on the Inſide of the Slip B, you have ,07, to which add ,4, and the Sum will be ,47, the Area of a Circle, whoſe Diameter is 13 Inches.

Then draw the Slip B out until 14 Inches appear, and againſt that you have ,546 for the Area of a Circle, whoſe Diameter is 14 Inches.

Draw this Slip further out until about 18,94 Inches appear, and againſt that you have 1 Gallon; and until you ſee 24,5 Inches appear, againſt this you have about 1,64 Gallons, for the Area of a Circle, whoſe Diameter is 24,5 Inches.

But if the Diameter be more than 24,5 Inches, you muſt faſten the Slip B at 24,5, and draw out the Slip C, and put it in it's Place again, ſo that 10 upon C may ſtand the contrary Way to what it does when uſed with the Line D; this being done, turn the inward Side of this Slip uppermoſt, and draw it out as Occaſion ſhall require, ſuppoſe to about 26,8 Inches, againſt that you will ſee 2, Gallons for the Area; if you have Occaſion to draw it out further, ſuppoſe until 32,8 appear, then againſt that you have 3 Gallons for the Area; and at 36 Inches Diameter, you have 3,61 for the Area of a Circle whoſe Diameter is 36 Inches: And thus you may find the Diameters and Areas of ſmall Tubs, or Veſſels uſed by Victuallers.

To extract the Square Root by the Rule.

This Rule is grounded upon the 4th *Prop.* of the 2d Book of *Euclid*'s *Elements*, but may be perſormed thus: Set thoſe Lines, which are noted with the Letters C and D, even; *i. e.* ſet 10 at the End of the Line D, to 10 which is at the End of the Line C; then theſe two Lines will be as a Table of Squares and their Roots; for againſt any Square on the Line C, you'll have it's Root on D.

When note, That when the Figures in the Number given are even, *i. e.* when they conſiſt of 2, 4, 6, or 8 Figures, (being Integers,) look the ſame in the ſecond *Radius* of the Line C, and againſt it you'll have the Square Root thereof on the Line D.

EXAMPLE.

Let 64 be given to have it's Square Root extracted.

RULE.

Having ſet the Lines C and D even, find 64 in the ſecond *Radius* of the Line C, and againſt it upon D, you'll find 8, the Square Root required.

In like manner as the Rule now ſtands, you'll find that	4 5 6 7	are the Square Roots of	16 25 36 49

When the Integers in the Number given are odd, as conſiſting of, 1, 3, 5, 7, or 9 Places, you muſt find it in the firſt *Radius* of the Line C, and againſt it you'll have the Root required on the Line D.

EXAMPLE.

Let 144 be given to have it's Square Root extracted.

OPERATION.

Find 144 upon the firſt *Radius* of the Line C, and againſt it on the Line D, you'll have 12, the Root required.

So will { 14,2 / 2,5 / 10. } be the Square Roots of { 201,64 / 6,25 / 100,

To know of how many Places the Root will conſiſt, you may (before you handle the Sliding Rule) point the Square given, as is before directed.

The Uſe of the Square Root by the Sliding Rule.

PROB. I.

To find a mean Proportional between any two given Numbers.

RULE.

Set either of the two given Numbers upon C, to the ſame on D; then againſt the other Number given on C, you'll find the Mean required on D.

EXAMPLE.

Find a mean Proportional between 64 and 256.

OPERATION.

Set 64 upon the Line C, to 64 on D; and then againſt 256 on C, you'll have 128, the Mean required on D.

PROB.

PROB. II.

Given the Conjugate and Tranſverſe Diameters of an Oval, to find the Diameter of a Circle, which ſhall be equal to the Oval in Area.

EXAMPLE.

Let the Conjugate Diameter of the Oval be 52,5, and the Tranſverſe 210.

OPERATION.

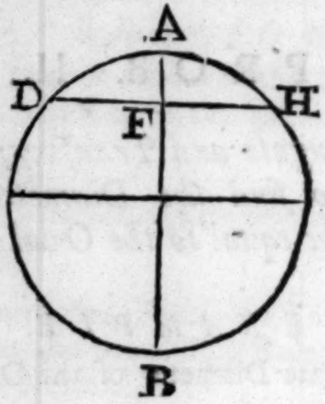
Set 52,5 upon the Line C, to 52,5 upon the Line D; then againſt 210 upon C, you'll have 105 on D, which is the Diameter required.

PROB. III.

Given AB *the Diameter of a Circle, and* AF, *the verſed Sine of it's Segment, to find* DH *the Chord Line. Let* AB *be* 46 *Inches, and* AF, 8; (DF *is a mean Proportional between* AF *and* BF *by the* 13*th of* Euclid *the* 6*th*.)

OPERATION.

Set 8 upon C, to 8 upon D; then againſt 38 = BF on C, you'll have 17,43 = DF, on D; which, doubled, gives DH the Chord Line required, which is 34,86 Inches.



To extract the Cube Root by the Lines E and D.

GENERAL RULE.

Place the two Lines, *viz.* E and D, even; *i. e.* place 1 at the Beginning of E, to 1 at the Beginning of D, then againſt any Cube upon the Line E, you'll have it's Root upon the Line D.

EXAMPLE I.

What's the Cube Root of 1728? Set the Rule even as above directed, then find 1728 upon the Line E, and againſt that on the Line D, you'll find 12, the Cube Root required.

EXAMPLE II.

What's the Cube Root of 6592? Set the Rule, and againſt 6592, upon the Line E, you'll find 18,75 upon the Line D, which is the Cube Root required.

Here note, That when the Integers in the given Cube conſiſt of 1, 4, or 7 Places, you muſt find it in the firſt *Radius* of the Line E; if of 2, 5, or 8, in the ſecond *Radius* of the Line E: But if of 3, 6, or 9 Places, then in the third *Radius* of the ſame Line. And here alſo you muſt point your Cube, as by the Pen you were before taught, to know the Number of Places in the Root.

The Uſe of the Cube Root by the Sliding Rule.

PROB. I.

There is a Bullet whoſe Diameter is 4 *Inches, and Weight* 9 *Pounds; what is the Weight of another Bullet, whoſe Diameter is* 16 *Inches?*

RULE.

Set 4, the Diameter given, on the Line D; to 9 *lb* the Weight of that Bullet upon the Line E; then againſt 16 upon the Line D, you'll find 576 upon the Line E; and that is the Weight of the Bullet required.

PROB. II.

There is a Bullet whoſe Diameter is 8 *Inches, and Weight* 72 *Pounds; I demand the Weight of another Bullet (of the ſame Metal) whoſe Diameter is* 4 *Inches.*

RULE.

Set 8 (the given Diameter) upon D, to 72 the Weight of it's Bullet on E; then againſt 4 upon D, you'll find 9 upon E, the Weight required. And, as the Rule now ſtands, you may find the Weight of all Bullets of that Metal;

tal; for againſt the Diameters upon D, you'll have the Weight on E.

Thus, if the Diameter of a Bullet be	3	Inches, the Weight will be	3,79	*lb.*
	5		17,57	
	6		30,37	
	7		48,23	

P R O B. III.

Having the Diagonal Line of a Cask taken as the middle Fruſtum of a Spheroid in Inches, to find the Content thereof in Beer Gallons.

R U L E.

Set 22,93 upon the Line D, to 27 upon the Line E; then againſt the Diagonal of any ſpheroidal Caſk upon D, you'll have the Content thereof upon the Line E, in Beer Gallons.

E X A M P L E.

Let the Diagonal of a Caſk be 20 Inches; I demand the Content thereof in Beer Gallons.

O P E R A T I O N.

Set 22,93 upon D, to 27 upon the Line E, then againſt 20 (the given Diagonal) upon D, you'll find 17,91 upon E, and that is the Content required. And as the Rule now ſtands, you'll find, that if the Diagonal Lines in Inches of any ſuch Veſſel

be	12.	The Content thereof in Beer Gallons will be	3,86
	22,93		27.
	48,59		257.

The foregoing Examples depend on the ſame Principle, on which I ſignified the former Problems in the Uſe of the

Cube Root Arithmetically did: *i. e.* that like Solids are in triplicate Proportion of their Homologous Sides; and on the ſame depend thoſe which follow.

PROB. IV.

Having the Diagonal of a Veſſel in Inches, to find the Content thereof in Wine Gallons.

RULE.

Set 15,9 upon D, to 11 upon E, and then againſt any Diagonal Line in Inches upon D, you'll have the Content of the Veſſel on E, in Wine Gallons.

EXAMPLE I.

Let the Diagonal of a Caſk in Inches be 50,49; I demand the Content in Wine Gallons.

OPERATION.

Set 15,9 upon D, to 11 upon E; then againſt 50,49 upon D, you'll have 352 upon E; and ſuch is the Content required in Wine Gallons.

EXAMPLE II.

Suppoſe the given Diagonal was 9,01; I demand the Content in Wine Gallons.

OPERATION.

Set 15,9 upon D, to 11 upon the firſt *Radius* of the Line E; then againſt 9,01 (the given Diagonal) on D, you'll find 2, upon the Line E, for the Content of the Veſſel in Wine Gallons.

The two laſt Problems will be of great Uſe where a four Feet Rule is not at Hand, to find the Content of Caſks (if upon the Sliding Rule you have the Lines E and D projected)

jected) only by knowing the Length of the Diagonal Line in Inches. But inſtead of theſe Lines, there's now commonly inſerted a Line of Numbers and Segments for a ſtanding Caſk, of which I ſhall ſpeak in it's proper Place; but theſe are not (in my Opinion) ſo neceſſary as the other. However, there yet remains another Way to find the Content of a ſpheroidal Caſk, in Beer or Wine Gallons, having the Length of the Diagonal Line in Inches, by Help of the Lines C and D. Thus for

BEER GALLONS.

Set 21,2 (a Gauge Point) upon D, to the Length of the Diagonal in Inches upon C; then againſt the ſame Diagonal on D, you will have the Content of the Veſſel in Beer Gallons upon C.

For WINE GALLONS.

Set 19,1 (a Gauge Point) upon D, to the Diagonal in Inches upon C; then againſt the ſame Diagonal on D, you'll have the Content upon C.

PROB. V.

There is a Conical Tun, whoſe Diameter at the Top is 20 *Inches, that of the Bottom* 26 *Inches, and the Depth* 30: *By which the Content (in Ale Gallons) appears to be* 44,45: *I demand the Diameter at the Top, the Diameter at the Bottom, and the Depth of another Conical Tun, whoſe Content is* 88,9 *Gallons.*

OPERATION.

1. To find the Diameter at the Top.

Set 44,45 upon E, to 20 upon the Line D; then againſt 88,9 upon E, you'll find 25,2, the Top Diameter required.

2. To find the Bottom Diameter.

Set 44,45 upon E, to 26 upon the Line D; then againſt 8,89 upon E, you'll find 32,75, the Bottom Diameter required on D.

For the Depth of the Conical Tun, whoſe Content is 88,9.

Set 44,45 upon the Line E, to 30 upon the Line D; then againſt 88,9 on E, you'll find 37,79, the Depth required upon D.

PROB. VI.

There is a Caſk whoſe Bung Diameter is 20 *Inches, it's Head Diameter is* 14, *and the Length* 24; *by which the Content appears to be* 22,19 *Beer Gallons; I demand the Bung, Head, and Length of another ſuch Veſſel, whoſe Content is* 40 *Gallons.*

OPERATION.

1. To find the Bung Diameter.

Set 22,19 upon E, to 20 upon D; then againſt 40 upon E, is 24,34, the Bung Diameter required.

2. To find the Head-Diameter.

Set 22,19 upon E, to 14 upon D; then againſt 40 upon E, you'll find 17,03 upon D, for the Head Diameter required.

3. To find the Length.

Set 22,19 upon E, to 24 upon D; then againſt 40 upon E, is 29,2, the Length required on D.

The Uſe of the Rule in Meaſuring Timber, Stone, Boards, *&c.*

PROB. I.

The Diameter of a Circle given, to find the Circumference.

RULE.

SET 1 upon A, to 3,14, *&c.* on B, (which Point is marked with C for Circumference,) and then againſt any Diameter on A, you'll find it's Circumference on B.

EXAMPLE.

Let the Diameter of a Circle be 40 Inches; what's the Circumference?

Set 1 on the Line A, to the Point c, on the Line B; then againſt 40, on the Line A, you'll find 125,66 on the Line B, and ſuch is the Circumference required.

PROB. II.

The Circumference given, to find the Diameter.

RULE.

Set the Point c. 3,141, *&c.* on B, to 1 on A; then againſt any Circumference on B, you'll find it's Diameter on A.

EXAMPLE.

Let the Circumference of a Circle be 125,66 Inches; what's the Diameter?

Set the Point c. upon the Line B, to 1 on the Line A; then againſt 125,66 on the Line B, you'll find 40, the Diameter required on A.

PROB. III.

The Diameter of a Circle given, to find the Side of a Square which ſhall be equal in Area thereto.

RULE.

Set the Point (S. e.) *i. e.* ,8862 on the Line B, to 1 on A; then againſt the Diameter of any Circle on A, you'll find the Side of an equal Square on B.

EXAMPLE.

Let the Diameter of a Circle be 40 Inches; what's the Side of an equal Square?

Set S. e. (ſignifying Square equal,) *i. e.* ,8862 on B, to 1 on A; then againſt 40 on A, is 35,44 on B, and ſo much is the Side of a Square, whoſe Area will be equal to that Circle, of which 40 is the Diameter.

PROB. IV.

The Diameter given, to find the Side of the greateſt Square that can be drawn within the Circle to which that is a Diameter.

RULE.

Set ,707106 marked with S. i. (ſignifying Square inſcribed) on B, to 1 on A; then againſt any Diameter on A, you'll find the Side of the inſcribed Square on B.

EX-

EXAMPLE.

Let the Diameter of a Circle be 40 Inches; what's the Side of the inſcribed Square?

Set the Point S. i. =,707, *&c.* on B, to 1 on A; then againſt 40 on A is 28,284, the Side of the Square required.

PROB. V.

The Diameter of a Circle given, to find the Area thereof.

Set 1 upon D, to ,78539 (marked with O, d.) on C; then againſt any Diameter on D, you'll find the Area required on C.

EXAMPLE.

Let the Diameter of a Circle be 30 Inches; what's the Area?

Set 1 upon D, to ,78539 on C; then againſt 30 on D, you'll find 706,85 on C, for the Area required.

PROB. VI.

The Circumference of a Circle given, to find the Area.

RULE.

Set 1 upon D, to ,079578 (marked with Θ *c.*) on C; then againſt any Circumference on D, you'll find the Area required on C.

EXAMPLE.

Let the Circumference of a Circle be 60 Inches; what's the Area?

Set 1 upon D, to ,079578 = Θ. c. on C; then againſt 60 on the Line D, is 286,48 on C, the Area required.

PROB. VII.

The Breadth of a Board given in Inches, and the Length in Feet, to find the Content in Feet.

RULE.

Set 12 on B, to the Breadth of the Board on A; then againſt the Length of the Board on B, you'll find the Content on A.

EXAMPLE.

Let the Breadth of a Board be 20 Inches, and the Length 18 Feet; what is the Content in Feet?

Set 12 on B, to 20 on A; then againſt 18 on B, is 30 on A, and that is the Area of the Board required.

PROB. VIII.

The Length and Breadth of a Board given in Inches, to find the Content in Feet.

RULE.

Set 144 on the Line B, to the Breadth of the Board on A; then againſt the Length on B, you'll find the Content on A.

EXAMPLE.

Let the Breadth of a Board be 20 Inches, and the Length 168; what's the Content in Feet?

Set 144 on B, to 20 on A; then againſt 168, on B, is 23,33 the Area required in Feet on A.

PROB.

PROB. IX.

The Breadth of a Board given in Inches, to find how much in Length thereof will go to make one Foot Square.

RULE.

Set the Breadth given in Inches on B, to 1 on A; then againſt 144 on B, you'll find how much of the Board muſt be accounted one Foot Square?

EXAMPLE.

Let a Board be 16 Inches broad, how much in Length will go to make one Foot Square?

Set 16 upon B, to 1 on A; then againſt 144 on B, is 9 on A; and ſo much of that Board will go to make one Superficial Foot. Or rather thus: Set 16 upon B, to 12 upon A; then againſt 12 upon B, you'll have 9, for the Anſwer upon A.

Of Timber or Stone.

PROB. X.

Let a Piece of Square Timber or Stone be given to be meaſured, whoſe Length is 14 Feet, and Side 17 Inches; what's the Content in Solid Feet?

Set 12 upon D, to the Length; *viz.* 14 Feet on C; then againſt the Side of the Square, *viz.* 17 Inches on D, you'll find 28,097 on C, which is the Content required.

But if the Dimenſions are given both in Foot Meaſure, then the Proportion is, *As* 1 upon D, is to the Length on C; ſo is the Side on D, to the Content on C.

PROB. XI.

Let a Piece of Timber be given, whoſe Length is 22 Feet, Breadth 18 Inches, and Depth 13; what's the Content in Solid Feet?

The common Way of meaſuring unequal-ſided Timber, is to add the Breadth and Depth together, then half that Sum is taken for the Square of the Piece: But this is an Error too commonly uſed. However, to proceed in our Buſineſs, you muſt find a mean Proportional betwixt the Depth and Breadth: Thus ſet 18 on C, to 18 on D, then againſt 13 on C, you'll find 15,29 on D, and that is the Side of a ſquare Piece of Timber; which being of the ſame Length with that given, will be equal to it; therefore ſet 12 on D, to 22 Feet, the Length of the Piece on C; then againſt 15,29 on D, you'll find 35,71 on the Line C; and ſo much is the Content of the Piece required.

PROB. XII.

The Side of any Square Piece of Timber given in Inches, to find how many Inches in Length of the ſame Piece will go to make one Foot Solid.

RULE.

Set the Side of the Square given on D to 1, on C; then againſt 41,5 on D, you'll find what's required on C.

EXAMPLE.

Let the Side be 15 Inches; how much in Length of the Piece will make one Foot Solid?

Set 15 on D, to 1 on C; then againſt 41,5 on D, is 7,68 on C; and ſo many Inches in Length will make one Foot Solid of that Piece.

Of Round Timber.

PROB. XIII.

Let the Circumference of a Round Tree be 40 *Inches, and the Length* 16 *Feet; what's the Content in Feet?*

RULE.

Always ſet 42,53 on D, to (the given Length in Feet, as in this Caſe) ,16 on C, then againſt the Circumference on D, *viz.* 40, you'll find 14,15 for the Content in Feet and Parts.

PROB. XIV.

Let the Circumference of a Round Tree be 92 *Inches; I would know how much thereof in Length would make one Foot Solid.*

RULE.

Set the Circumference, *viz.* 92 on D, to 12 upon C; then againſt 42,53 (a fixed Number for this Purpoſe) on D, you'll find the Length of a Foot required upon C, *viz.* 2,56. And the like may be done by any other Queſtion of the like Nature. But ſuch Perſons as deſire to ſee more of this, may peruſe Mr *Everard*'s *Stereometry*, the Third or Fourth Edition.

And having thus given Directions to a Perſon who deals in Boards, Timber, or Stone; 'twill next be convenient to add ſomething further about the Meaſuring of Wainſcot, Plaiſtering, and Paving; which are generally agreed for by the Yard.

And therefore, when you have taken your Dimenſions in Feet, and caſt them up, divide the Sum by 9, ſo will you have the Content in Square Yards.

In taking the Dimenſions (with a Line) you are to girth over every Turn or Part of the Corniſh, and all Parts of the Wainſcot where the Mouldings ſwell much, from the Top of the Room to the Bottom, turning the Line over every ſuch Part with the Thumb of your Right-Hand.

But you muſt girth the Room without turning the Line upon the Mouldings, as you do in taking the Heighth.

Where obſerve, that, in meaſuring Window-Shutters and Doors, you muſt allow Meaſure and half Meaſure; that is, whatever you meaſure a Door or a Shutter at, it muſt be accounted Half as much more.

EXAMPLE.

The Heighth of a Room is 14 Feet 9 Inches, and Compaſs 146 Feet 6 Inches.

In which there are two Doors, each 6 Feet 3 Inches long, and 4 Feet wide.

Alſo 4 Windows, each 2 Leaves for Shutters, which are 5 Feet 2 Inches high, and two Feet broad.

What's the Content of ſuch a Room in Square Yards?

Compaſs of the Room is	146,5	
It's Heighth	14,75	
	7325	
	10255	
	5860	
	1465	
Content of the Room	2160,875	Square Feet.

Including Doors, Windows, and Chimney.

One Leaf of a Window-Shutter is	5.166	Feet long.
	2.	wide.
Content of one in Square Feet is,	10,332	
Number of Shutters or Leaves	8.	
Content of all in Square Feet	82,656	

	Feet.	
Length of one Door is	6,25	
And Breadth	4.	
Content in Square Feet	25,00	
Number of Doors	2.	
Their Content	50.	
To which add the Shutters	82,656	
Their Sum is	132,656	
Half their Sum is	66,328	for half Work.
To this add the Room	2160,785	
The Content is	2359,769	

The

	F. In.	
The Heighth of a Chimney is	4 : 6 =	4,5
It's Breadth is	3 : 3 =	3,25
		14,625
		282,4155

Content of the Chimney is	14,625
Which take from the Content above	2359,769
And there will remain the true Content of the Room	2345,144

Which divide by 9, will give Square Yards.

9) 2345,144 (260,571 Yards.
18
―――
54
54
―――
051
45
―――
64
63
―――
14
9
―――
5

Painters take their Dimenſions, and caſt up, as Joiners do, but are not to account for Work and Half, but to account (in ſome Caſes) the Room once, twice, or three Times done over, or ſo much *per* Yard, conſidering the

Goodneſs of the Work; as white Painting is worth about 1 Shilling *per* Yard; Walnut-Tree Painting is worth 1 *s.* 4 *d.* or 1 *s.* 6 *d.* *per* Yard, and ordinary Branch Painting is worth 12 *d.* 14 *d.* or 16 *d.* *per* Yard; Japan Work, Plain, either Black or White, is worth 3 *s.* 6 *d.* or 4 *s.* *per* Yard, Gates and Out-doors are worth Painting 8 *d.* or 9 *d.* *per* Yard.

By the Sliding Rule.

Say, as 9 upon B, is to the Breadth upon A; ſo is the Length upon B, to the Content in Square Yards upon A.

EXAMPLE.

Let the Length be 76,5 Feet, and Breadth 17,5 Feet; what's the Content in Square Yards?

Set 9 upon B, to 17,5 upon A; then againſt 76,5 on B, is 148,75 Square Yards upon A.

And the ſame Method ſerves either in Painting, Plaiſtering, Joinery, or Paving.

But 'tis common among Plaiſterers to make no Allowance for Doors, Windows, or Chimnies.

For Flooring, Partitioning, Roofing, &c.

Partitioning, Flooring, Roofing, and Tiling, are meaſured by the Square of Ten, each Square being 100 Feet.

EXAMPLE I.

Let the Length of a Floor be 76,2 Feet, and it's Breadth 22,6 Feet, to find it's Content in Squares.

```
    100 : 76,2 : : 22,6
              22,6
            ------
              4572
             1524
            ,1524
           -------
Anſwer     17,2212  Squares.
```

By the Sliding Rule, ſet 100 on B, to 76,2 on A; then againſt 22,6 on B, you'll find 17,22 on A.

EXAMPLE II.

Let the Length of a Building be 125 Feet, and Breadth 49; I demand how many Squares of Roofing or Tiling it contains.

As 100 the Square Feet in a Square, is to 75,5, (twice the Length of the Rafter in Feet,) ſo is the Length 125, to 94,375 the Content in Squares, (*i. e.*)

```
100 : 75,5 : : 125.
          125.
        ------
          3775
         1510
         755
        ------
        94,375
```

By the Sliding Rule, ſet 100 on B, to 125 on A; then againſt 75,5 on B, is 94,37 on A, as above.

Here obſerve, That the Breadth of the Floor, is to the Length of the Rafter, as 4 to 3, to which you muſt add the Vallies and Eves.

To

To Meaſure Brick Work.

Brick Work is caſt up by the Rod Square, each containing 272,25 Square Feet.

Where you muſt remember, that all Brick Work muſt be reduced to the Standard Meaſure of one Brick and Half thick, which may moſt eaſily be done by the Help of the following Table; which goes as far as any Brick Wall is in Thickneſs at this Time.

EXAMPLE I.

Let the Height of a Wall be 22,5 Feet, and Length 156,25; I demand the Content in Square Rods at 1 Brick and ½ Thick.

Look in the Table for the given Thickneſs, *viz.* 1,5, and againſt it you'll find 272,25; then ſay

```
272,25 : 156,25 : : 22,5
           22,5
         ------
          78125
         31250
        31250
        --------
272,25) 3515,6250  (12,91 Anſwer
        793120(5
          24860(7
            036(7
              (8
```

EXAMPLE II.

Let the Height of a Wall be 2 Bricks Thick, 243 Feet Long, and 16,2 Feet High; what's the Content in Square Rods?

Look in the Table for 2,0, and againſt it you'll find

```
204,19 : Then ſay
204,19 : 243, : : 16,2
         16,2
         ----
          486
         1458
         243
         -----------
204,19)  3936,6000   (19,27 Anſwer
         20419
        -------
         189470
         183771
         -------
           56990
           40838
           ------
           161520
           142933
           ------
            18587
```

Suppoſe this Wall to have a Water Table 3 Bricks Thick, and 4 Feet High; what's the Content of the whole Wall ? Againſt 3 in the Table, you'll find 136,12; then ſay

```
136,12 : 243, : : 4
            4
         ---------
136,12)  972,0000  (7,14
          95284
          -------
           19160
           13612
           -------
            55480
            54448
            -----
             1032
```

The upper Part of the Wall is	19,27	Square Rods.
The Water Table is	7,14	
The whole Content of the Wall	26,41	

When you meaſure Brick Work, you muſt find the Content of each Wall ſeverally, and from it ſubtract all the Doors and Windows.

By the *Sliding Rule.*

Set 272,25 on B, to the Length of a Wall (of any Thickneſs) on A; then againſt the Breadth on B, you'll find the Content in Square Rods on A; if the Wall be juſt 1 ½ Brick Thick, but if more or leſs, 'twill require a ſecond Operation, thus: Set 3 on B, to the Number of half Bricks the Wall is thick on A; then againſt the Content or fourth Number found by the firſt Operation, on B, you'll find the true Content of the Wall, *&c.* on A: Or, ſet the tabular Number ſound againſt the Thickneſs on B, to the Length of a Wall on A; then againſt the Breadth on B, you'll find the Content on A, at once.

Bricks Thick.	Square Feet in a Rod.
0,5	816,75
1,0	403,37
1,5	272,25
2,0	204,19
2,5	163,35
3,0	136,12
3,5	116,67
4,0	102,09
4,5	90,75
5,	81,68
5,5	74,25
6,	68,06
6,5	62,82
7,	58,34
7,5	54,45
8,	41,04
8,5	48,04
9,	45,37
9,5	42,98
1,0	40,83

Note, That about a Thouſand of Bricks will do a Rod of Work on a two Brick Wall.

The laying of which Number will be about a Day's Work for a Bricklayer and a Labourer.

Glaſiers meaſure their Work by the Foot Square, and is the ſame with that of meaſuring Boards; the Dimenſions of either may be taken in Feet and Inches, and the Content found by croſs Multiplication.

EXAMPLE.

	F. In.
Let the Breadth of a Pane of Glaſs be	4 : 3
And it's Length	6 : 6
	24 :
	1 : 6
	2 : 0
	0 : 1 : 6
Content in Square Feet, Inches, and Parts	27 : 7 : 6

Which is done thus.

1. Firſt multiply 4 Feet by 6 Feet, and the Product is 24 Feet; which ſet under F.

2. Then 3 Inches by 6 Feet, gives 18 Inches, or 1 Foot 6 Inches; which ſet down under the former, as you ſee.

3. Multiply 4 Feet by 6 Inches, the Product is 24 Inches, or 2 Feet.

Multiply 3 Inches by 6 Inches, and the Product is 18 Parts; which divide by 12, and the Quotient is 1 Inch, and 6 Parts remain, which ſet down.

Laſtly, Add all into one Sum, and you'll have the Anſwer, *viz.* 27 Feet, 7 Inches, and 6 Parts.

And after the ſame Manner, you may caſt up any Thing elſe, whoſe Dimenſions are given in Feet and Inches, *&c.*

In many Caſes, 'twill be neceſſary to take your Dimenſions in Feet, Inches, and Parts, *i. e.* to Halves and Quarters, (as in Glazing, *&c.*) in which, for a Quarter of an Inch, ſet down 3 Parts.

For half an Inch, you muſt ſet down 6 Parts.

And for three Quarters of an Inch, 9 Parts, (ſuppoſing 12 Parts make an Inch as 12 Inches do a Foot;) here note, That

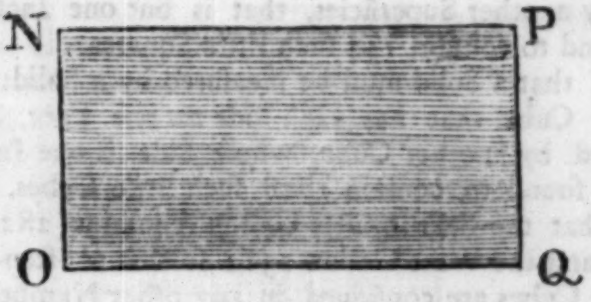
Feet multiplied by Feet, give Feet.
Feet by Inches, give Inches.
Feet by Parts, give Parts.
Inches by Inches, give Parts.
Inches by Parts, give Seconds.
Parts by Parts, give Thirds.

Gauging performed Arithmetically and Inſtrumentally.

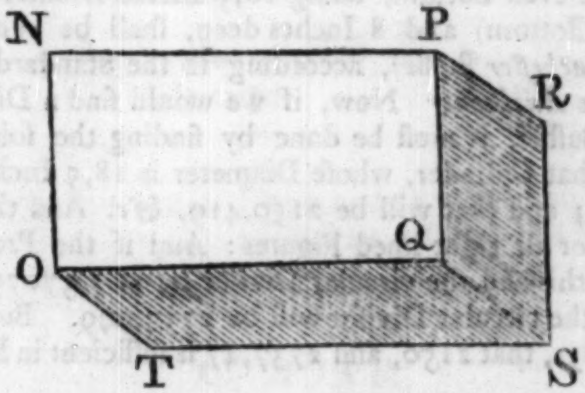
WHEN the young Gauger has ſtored his Memory with the foregoing Notions, he may venture upon this Part; but firſt ought to know ſomething of the *Geneſis* of Quantity, *i. e.* That a Point begets a Line, as the Point A, moved from B to C, will leave the Trace, or deſcribe the Line B C.

A (.) B ———————— C.

And a Line begets a Surface, if we conceive it to be moved through any Space, parallel to itſelf, as we conceive the Line B C to be moved parallel to itſelf, between the Lines N O and P Q, it will, by that Motion, deſcribe the Surface N O P Q.



Laſtly, If we imagine this Surface to ſink perpendicularly and parallel to itſelf, it will, by ſuch a Motion, deſcribe a Solid, as NOPQRST.



1. A Point is ſaid to be that which has no Parts.
2. A Line is that which has Length, but not Breadth.
3. A Surface is that which has both Length and Breadth.
4. A Solid admits of Length, Breadth, and Thickneſs.

Having a clear Apprehenſion of what has been ſaid, we are to learn, that a Line is meaſured by a Line; as a Line 2 Feet long, may be meaſured by a Line that is one Inch long, and be found to contain 24 ſuch.

And that a Superficies muſt be meaſured by a Superficies: So a Superficies that is one Foot ſquare, may be meaſured

ſured by another Superficies, that is but one Inch ſquare, and found to contain 144 ſuch little Squares.

Alſo, that a Solid muſt be meaſured by a Solid.

So a Cube that has each Side = one Foot, may be meaſured by another Cube, whoſe Side is one Inch, and will be found to contain 1728 ſuch little Cubes. *Where note*, That the Beer or Ale Gallon contains 282 cubical Inches, and the Wine Gallon 231; ſo that as often as either of theſe Cubes are contained in any other Number of cubical Inches, ſo many Beer or Wine Gallons are contained therein.

Where note alſo, That it was Enacted in the Act for laying a Duty upon Malt, that every round Buſhel with a plain and even Bottom, being 18,5 Inches Diameter (from Top to Bottom) and 8 Inches deep, ſhall be eſteemed a legal *Winchcſter* Buſhel, according to the Standard in her Majeſty's *Exchequer* Now, if we would find a Diviſor for a Malt Buſhel, it muſt be done by finding the ſolid Content of that Cylinder, whoſe Diameter is 18,5 Inches, and Depth 8; and that will be 2150,419, *&c.* And this is the Diviſor for all right-lined Figures: And if the Proportion between this and the circular Diviſor is, as 1,570796 to 2, (as it is) the circular Diviſor will be 2737,999. But Mr *Everard* ſays, that 2150, and 2737,47 is ſufficient in Practice.

To Gauge a *Square.*

DEFINITION.

A Square has all it's Sides equal, and it's Angles right.

RULE.

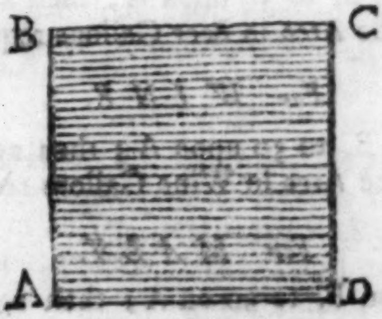
Square the Side, and divide the Square by 282 for Beer Gallons, 231 for Wine, and 2150 for Malt.

EX-

EXAMPLE.

Let the Side BC of the Square ABCD be 30 Inches; I demand the Area in Beer, Wine, and Malt.

FIGURE.



For BEER.

Side = 30
30
282) 900,000 (3,191 Area in Beer Gallons at one Inch deep.
054828
2543
01

For WINE.

231) 900,000 (3,896 Area at one Inch deep in Wine Gallons.
207214
2242
10

For MALT BUSHELS.

2150) 900,0000 (,4186 Area in Malt.
0400000
18500
131
0

By the *Sliding Rule.*

For BEER.

Set 282 upon B, to 30 upon A; then againſt 30 on B, is 3,19 on A, the Area in Beer Gallons required.

For WINE.

Set 231 upon B, to 30 upon A; then againſt 30 on B, is 3,89 on A, the Area in Wine Gallons required.

For MALT.

Set 2150 upon B, to 30 on A; then againſt 30 on B, is ,4186 on A, the Area in Malt. Here you are to know, that this may be called the Rule of Three by the Lines. For as 282 is to 30, ſo is 30 to 3,191, *i. e.* in that Rule you muſt ſet the firſt Number in the Proportion on B, to the ſecond on A; then againſt the third on B, you'll find the fourth required on A, *&c.* The Gauge Points for a Square, or other right-lined Figures (when reduced to a Square) are

For Beer Gallons ——	16,79
For Wine —— ——	15,19
And for Malt Buſhels ——	46,36

Theſe being the Square Roots of the Diviſors, 282, 231, and 2150, by them being ſet upon D, you may find the Area of a Square. Thus,

Set them ſeverally upon D, to 1 upon C; then againſt the Side of the given Square upon D, you will find the Area in Beer, Wine, and Malt upon C.

Or, you may find the ſame at one Set of the Rule. Thus,

Firſt, put the Sliding Piece C, the reverſe Way into it's Place; then ſet 1 upon C, to the Side of the Square upon D; and againſt 16,79 upon D, you'll have 3,191 upon C.

Againſt 15,19 upon D you'll have 3,896 upon C, and againſt 46,36 upon D, you'll have ,4186 upon C as before.

To Gauge a *Parallelogram.*

DEFINITION.

A Parallelogram is a four-ſided Figure, whoſe two oppoſite Sides (A B, C D or A C, B D) are parallel Lines.

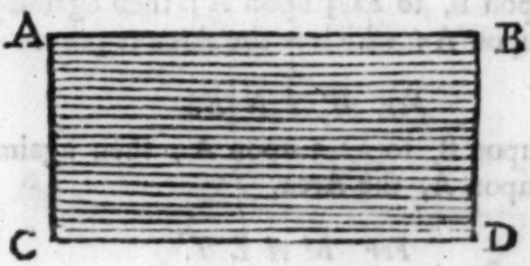
RULE.

Multiply the Length by the Breadth; then divide the Product by 282 for Beer Gallons, 231 for Wine, and 2150 for Malt Buſhels.

EXAMPLE.

Let A B C D be a Parallelogram, whoſe Length A B or C D is 40 Inches, and it's Breadth A C or B D 22,3; what's the Area in Beer, Wine, and Malt?

FIGURE.



For BEER.

Breadth 22,3
Length 40
282) 892,0000 (3,1631, the Area required.
0468848
17835
000

For WINE.

Breadth 22,3
Length 40

231) 892,0000 (3,8614 Area.
199249(6
1430(6
1(1

For MALT.

2150) 892,0000 (,4148 Area.
32000(0
1050(0
12(8
(1

By the *Sliding Rule.*

For BEER.

Set 282 upon B, to 22,3 upon A; then againſt 40 upon B, is 3,163 upon A; which is the Area required.

For WINE.

Set 231 upon B, to 22,3 upon A; then againſt 40 on B, is 3,861 upon A, the Area.

For MALT.

Set 2150 upon B, to 22,3 upon A; then againſt 40 on B, you'll have ,4148 on A, the Area in Malt.

Or, by Problem the firſt of the Uſe of the Square Root by the Sliding Rule, find a mean Proportional between 40 and 22,3, and that will be 29,87, which is the Side of a Square equal to the Parallelogram, by which, and the former Gauge Points, you may find the ſeveral Area's as you did for the Square.

To

To Gauge a Rhombus.

DEFINITION.

A Rhombus has equal Sides, but unequal Angles.

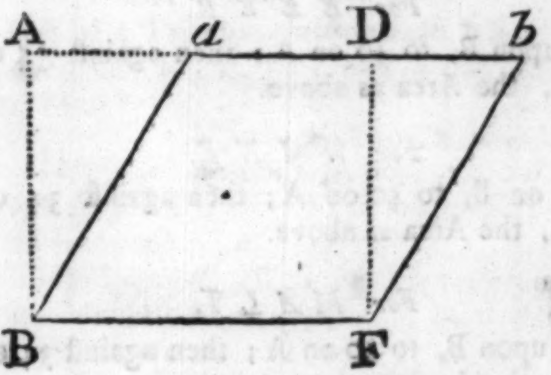
RULE.

It is demonſtrated by the 35th Propoſition of the firſt Book of *Euclid*, that Parallelograms having the ſame Baſe, and being between the ſame Parallels, are equal, *i. e.* that the Parallelogram A B D F is equal to the Rhombus *a b* B F; therefore, if you multiply B F by B A or D F, the Product will be the Area in Inches; which divide by 282 for Beer Gallons, 231 for Wine, and 2150 for Malt Buſhels.

EXAMPLE.

Let *a b* B F be a Rhombus, whoſe Side B F is 40 Inches, (= A D = *a b* = *b* F,) and let the neareſt Diſtance of any two oppoſite Sides, *e. g.* *a b* and B F, *i. e.* D F = A B be 34 Inches; I demand the Area in Beer, Wine, and Malt.

FIGURE.



For BEER.

BF = 40
DF = 34   *Gall.*

```
282) 1360,000 (4,822 Area.
       232466
        9679
          01
```

For WINE.

```
231) 1360,000 (5,887 Area.
       205223
         2070
           11
```

For MALT.

```
2150) 1360,0000 (,6325 Area.
        0700000
          05505
            122
              1
```

By the *Sliding Rule.*

For BEER.

Set 282 upon B, to 40 on A; then againſt 34 on B, is 4,822 on A, the Area as above.

For WINE.

Set 231 on B, to 40 on A; then againſt 34 on B, is 5,887 on A, the Area as above.

For MALT.

Set 2150 upon B, to 40 on A; then againſt 34 on B, is ,6325 on A, the Area as above.

To Gauge a Triangle.

DEFINITION.

Triangles have various Species; firſt in Relation to their Sides, one is called Equilateral, or equal-ſided.

Another Equicrural having two Sides equal: And a third Scalenum, becauſe all it's Sides are unequal; and in general, a Triangle is a Figure bounded with three right Lines.

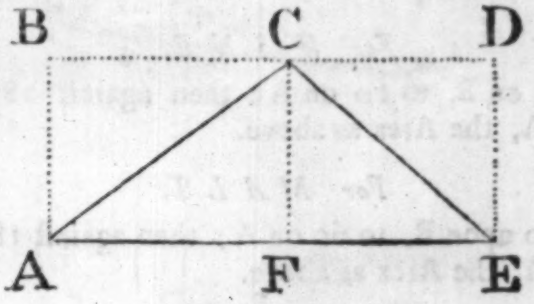
RULE.

Euclid in the 41ſt of his firſt Book proves, that a Parallelogram will be double to a Triangle, if they be between the ſame Parallels, and have equal Baſes; as the Triangle A C E is but half the Parallelogram B D E A, for the Triangle A C F is but half the Parallelogram B C A F, and the Triangle F C E is half the Parallelogram F C D E; therefore A C E = half B D E A. Q. E D.

Therefore multiply the Baſe A E by half the Perpendicular F C, and the Product is the Area in Inches; which divide by 282 for Beer Gallons, 231 for Wine, and 2150 for Malt.

EXAMPLE.

Let A C E be a Triangle, whoſe Baſe A E is 60 Inches, and Perpendicular F C = 36; what's the Area in Beer, Wine, and Malt?



For

For B E E R.

AE the Baſe = 60
half the Perp. FC = 18

282) 1080,000 (3,829 Area.
234462
0872
22

For W I N E.

231) 1080,000 (4,675 Area.
156435
1727
10

For M A L T.

2150) 1080,0000 (,5023 Area.
0050000
5005
075
0

By the *Sliding Rule.*

For B E E R.

Set 282 upon B, to 60 on A; then againſt 18 on B, is 3,829 on A, the Area as above.

For W I N E.

Set 231 on B, to 60 on A; then againſt 18 on B, is 4,675 on A, the Area as above.

For M A L T.

Set 2150 upon B, to 60 on A; then againſt 18 on B, is ,5023 on A, the Area as above.

To

To Gauge a Trapezium.

DEFINITION.

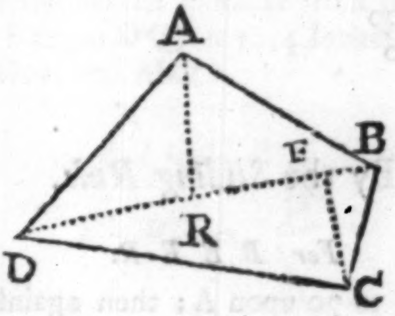
A Trapezium is a Figure conſiſting of four unequal Sides, as A B C D.

RULE.

Having divided the Trapezium into Triangles, as in the Figure following, add the two Perpendiculars, *viz.* A R and F C together, and multiply that Sum by half the Baſe B D, and the Rectangle or Product is the Area in Inches; which divide by 282 for Beer Gallons; 231 for Wine, and 2150 for Malt Buſhels.

EXAMPLE.

Let A B C D be a Trapezium, let the common Baſe D B be 102 Inches, the Perpendicular A R 40, and F C $=$ 30; I demand the Area in Beer, Wine, and Malt.



For

For BEER.

A R = 40
F C = 30
Sum = 70
½ D B = 51

282) 3570,000 (12,659 Area.
0756802
18676
121

For WINE.

231) 3570,000 (15,454 Area.
1265656
10202
111

For MALT.

2150) 3570,000 (1,660 Area.
1420000
13000
010
1

By the *Sliding Rule*.

For BEER.

Set 282 on B, to 70 upon A; then againſt 51 on B, is 12,659 on A, the Area required.

For WINE.

Set 231 on B, to 70 upon A; then againſt 51 on B, is 15,454 on A, the Area required.

For MALT.

Set 2150 upon B, to 70 on A; then againſt 51 on B, is 1,660 upon A, the Area as above.

To Gauge a Hexagon.

DEFINITION.

A Hexagon is a Polygon of ſix equal Sides, and as many equal Angles; as ABCDEF.

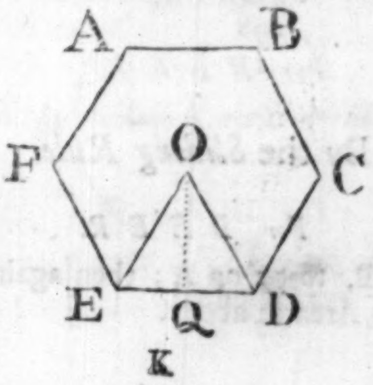
RULE.

All ſuch Polygons (whatever be the Number of their Sides) may be meaſured by one general Rule, *viz.* Multiply the Sum of all their Sides, by half the Diſtance of any Side from the Center, and divide the Product by 282 for Beer Gallons, 231 for Wine, and 2150 for Malt.

EXAMPLE.

Let ABCDEF be a Hexagon; any of whoſe Sides is 12 Inches, and the neareſt Diſtance from the Center to the Middle of any Side, as OQ, is 11,4 Inches; what's the Area in Beer, Wine, and Malt?

FIGURE.



For B E E R.

12
6
—
Sum of the Sides = 72
Half the Perpendicular 5,7
———
504
360
———
282) 410,400 (1,455 Area.
128600
1559
10

For W I N E.

231) 410,400 (1,776 Area.
179734
1754
11

For M A L T.

2150,) 410,4000 (,1908 Area.
954000
01900
198
1

By the *Sliding Rule.*

For B E E R.

Set 282 upon B, to 72 on A; then againſt 5,7 on B, is 1,455 on A, the Area as above.

For

For WINE.

Set 231 upon B, to 72 on A ; then againſt 5,7 on B, is 1,776 on A, the Area as above.

For MALT.

Set 2150 upon B, to 72 on A ; then againſt 5,7 on B, is ,1908 on A, the Area as above.

To Gauge a Circle.

DEFINITION.

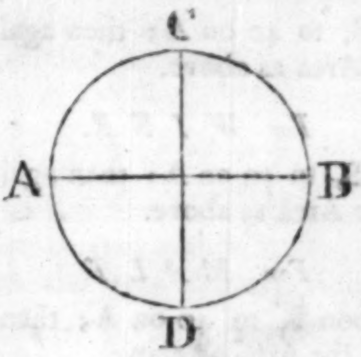
A Circle is a plain Figure, terminated by the Incompaſſing of one Line, which is called the Circumference, and is every where equally remote from the middle Point or Center.

RULE.

Divide the Square of the Diameter of any Circle by 359 for Beer Gallons, 294 for Wine, and 2737,47 for Malt.

EXAMPLE.

Let ABCD be a Circle, whoſe Diameter AB is 40 Inches ; what's the Area in Beer, Wine, and Malt ?



For BEER.

The Diameter = 40 Inches.
40

359) 1600,000 (4,456 Area.
164456
2049
22

For WINE.

294) 1600,0000 (5,4421 Area.
130442(6
1265(2
00(2

For MALT.

2737,47) 1600,00000 (,584 Area.
23126542
122675
1317

By the *Sliding Rule.*

For BEER.

Set 359 upon B, to 40 on A; then againſt 40 on B, is 4,456 on A, the Area as above.

For WINE.

Set 294 upon B, to 40 on A; then againſt 40 on B, is 5,4421 on A, the Area as above.

For MALT.

Set 2737,47 upon B, to 40 on A; then againſt 40 on B, is ,584 on A, the Area as above.

Or rather thus, the Gauge Points for a Circle being

18,94 for Beer Gallons, marked upon the Line D, with A G.

17,14 for Wine Gallons, marked upon the Line D, with W G.

52,32 for Malt Buſhels, marked upon the Line D, with M R.

Set theſe ſeverally upon D, to 1 upon C; then againſt 40, the Diameter upon D, you will have the ſeveral Areas (as above) upon C.

Or you may find theſe Areas, at one Set of the Rule, thus; ſet the Diameter 40 upon D, to 1 upon C (the Sliding Piece C being put the reverſe Way into it's Place) then againſt the ſeveral Gauge Points above mention'd upon D, you'll have the Areas upon C, as before.

To Gauge a Sector of a Circle.

DEFINITION.

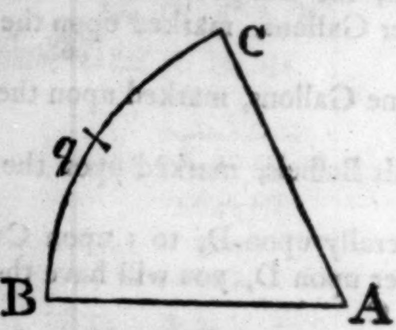
A Sector of a Circle is contained upon the Ends of two right Lines or Semi-diameters, making an Angle in the Center, having any Part of the Circumference for it's Baſe.

RULE.

Multiply the *Radius* or Semi-diameter A B or A C by Half the Arch, of the Section B C, *i. e.* C *q*, and divide the Product by 282 for Beer Gallons, 231 for Wine, and 2150 for Malt.

EXAMPLE.

Let A B *q* C be a Sector of a Circle, and let the *Radius* A B = A C be 40 Inches, and BC = 20, then is B *q* = C *q* = 10; I demand the Area in Beer, Wine, and Malt.



For B E E R.

Radius A B or A C = 40
Half the Arch Line B C = 10

282) 400,000 (1,418 Area.
118284
0532
21

For W I N E.

231) 400,000 (1,731 Area.
16937(9
73(3
(1

For M A L T.

2150) 400,0000 (,1860 Area.
1850000
13000
10
10

By the *Sliding Rule.*

For B E E R.

Set 282 upon B, to 40 on A; then againſt 10 on B, is 1,418 on A, the Area as above. *For*

For *WINE.*

Set 231 upon B, to 40 on A; then againſt 10 on B, is 1,731 on A, the Area as above.

For *MALT.*

Set 2150 upon B, to 40 on A; then againſt 10 on B, is ,1860 on A, the Area as above.

To Gauge an Oval.

DEFINITION.

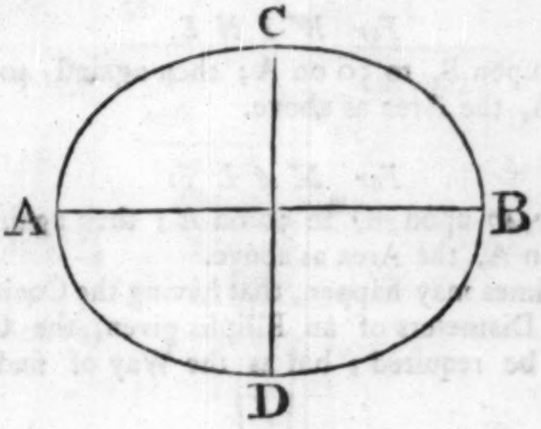
An Oval or Ellipſis is a circular Figure, as A B C D, having two unequal Diameters, as A B, which is called the Tranſverſe, and C D the conjugate Diameter, and proved by *Archimedes* to be a mean Proportional between the two Circles that may be deſcribed ſeverally on theſe Diameters.

RULE.

Multiply the tranſverſe Diameter A B, by the conjugate Diameter C D; then divide the Product by 359 for Beer Gallons, 294 for Wine, and 2737,47 for Malt Buſhels.

EXAMPLE.

Let the Figure A B C D be an Oval or Ellipſis, whoſe conjugate Diameter C D let be 40 Inches, and tranſverſe Diameter A B 50; what's the Area thereof in Beer, Wine, and Malt?



For

For B E E R.

AB=50
CD=40

359) 2000,000 (5,571 Area.
205571
2531
00

For W I N E.

294) 2000,000 (6,802 Area.
236802
0081
02

For M A L T.

2737,47) 2000,0000 (,73 Area.

By the *Sliding Rule.*

For B E E R.

Set 359 upon B, to 50 on A; then againſt 40 on B, is 5,571, the Area as above.

For W I N E.

Set 294 upon B, to 50 on A; then againſt 40 on B, is 6,802 on A, the Area as above.

For M A L T.

Set 2737,47 upon B, to 50 on A; then againſt 40 on B, is ,73 on A, the Area as above.

It ſometimes may happen, that having the Conjugate and Tranſverſe Diameters of an Ellipſis given, the Circumference may be required; but as the Way of finding it is not often put in Books of this Sort, we will give three different Ways of finding it.

To find the Circumference of an Ellipſis, by having the Tranſverſe and Conjugate Diameters given.

1. In the Woman's Almanack for the Year 1737, you have a Rule for this Purpoſe, which is

To twice the Square Root of the Sum of the Squares of the Tranſverſe and Conjugate Diameters, add one third Part of the Conjugate Diameter, and the Sum will be the Periphery of the Ellipſis within one hundredth Part of the whole.

EXAMPLE.

Let the Tranſverſe Diameter be AB = 50, and the Conjugate CD = 40, what's the Circumference ACBD?

```
        AB = 50                    CD = 40
             50                         40
        AB□ = 2500                 CD□ = 1600
              1600
AB□ + CD□ = 4100,00000000 (64,0312 Square Root.
            36                    2
   124)     500             128,0624
            496              13,3333 = 40 ÷ 3
  12803)    040000          141,3957 Anſwer = the
             38409                     Circumfer.
 128061)     159100
             128061
1280622)      3103900
              2561244
               542656
```

2. For the ſame Purpoſe, *Simpſon* has given us the following Series in his *Fluxions*, Page 127. *viz.* $1 - \frac{d}{4} - \frac{3d^2}{64} - \frac{45d^3}{2304} - \frac{1575d^4}{14745}$ &c. to Unity, *d* being equal to the Difference of the Squares of the two given principal Diameters, divided by the Square of the Tranſverſe Diameter.—Thus let the Tranſverſe Diameter be 50, and Conjugate 40,

$$\begin{array}{rr} 50, & 40, \\ 50, & 40, \\ \hline 2500, & 1600, \\ 1600, & \\ \hline \end{array}$$

2500,) 900,00 (,36 $= d$

Now according to the Series,	$d = ,36 \div 4, =$	,09
And - - -	$3d^2 \div 64, =$	,00607
And - - -	$45d^3 \div 2304,$	,0009112
Their Sum is - - - - -		,0969812
Take this Sum from - - -		1,0000000
Remains - - - - - -		,9030188

Having done ſo far, ſay as 1 : 3,1416 : : ſo is the Tranſverſe Diameter 50 to 157,08 = the Circumference of a Circle, whoſe Diameter is equal to the Tranſverſe Diameter of the Ellipſis. Multiply this by the ſaid Remainder ,9030188, and the Product is 141,846193104 for the Periphery of the Ellipſis, as required. Note, That though the Series runs to $\frac{1575d^4}{14745}$, yet you need go no further than $\frac{45d^3}{2304}$, as above.

A TA-

A TABLE for finding the Periphery of an Ellipſis, calculated by Sir *Jonas More.*

Axe.	Periph.	Axe.	Periph.	Axe	Periph.	Axe.	Periph.
.1	2.0012	.26	2.1561	.51	2.4342	.76	2.7745
.2	2.0028	.27	2.1658	.52	2.4467	.77	2.7891
.3	2.0048	.28	2.1756	.53	2.4594	.78	2.8038
.4	2.0072	.29	2.1856	.54	2.4723	.79	2.8186
.5	2.0100	.30	2.1956	.55	2.4852	.80	2.8334
.6	2.0133	.31	2.2056	.56	2.4983	.81	2.8482
.7	2.0170	.32	2.2160	.57	2.5114	.82	2.8632
.8	2.0213	.33	2.2264	.58	2.5245	.83	2.8779
.9	2.0261	.34	2.2368	.59	2.5377	.84	2.8929
.10	2.0314	.35	2.2474	.60	2.5510	.85	2.9080
.11	2.0370	.36	2.2561	.61	2.5644	.86	2.9231
.12	2.0432	.37	2.2692	.62	2.5779	.87	2.9382
.13	2.0496	.38	2.2803	.63	2.5915	.88	2.9534
.14	2.0564	.39	2.2915	.64	2.6052	.89	2.9686
.15	2.0634	.40	2.3028	.65	2.6189	.90	2.9839
.16	2.0708	.41	2.3142	.66	2.6327	.91	2.9993
.17	2.0784	.42	2.3256	.67	2.6465	.92	3.0147
.18	2.0862	.43	2.3371	.68	2.6604	.93	3.0307
.19	2.0944	.44	2.3488	.69	2.6744	.94	3.0458
.20	2.1024	.45	2.3607	.70	2.6884	.95	3.0614
.21	2.1106	.46	2.3726	.71	2.7025	.96	3.0770
.22	2.1192	.47	2.3848	.72	2.7166	.97	3.0928
.23	2.1281	.48	2.3970	.73	2.7309	.98	3.1086
.24	2.1373	.49	2.4094	.74	2.7453	.99	3.1242
.25	2.1467	.50	2.4218	.75	2.7599	100	3.1402

To find the Periphery of an Ellipſis by the preceding Table, ſay, As the longeſt or Tranſverſe Diameter of an Ellipſis is to the ſhorteſt or Conjugate Diameter, ſo is 1,00 the tabular longeſt Diameter of the Ellipſis to a Number, againſt which in the Table under Axe, you have the Periphery of an Ellipſis, whoſe longeſt Diameter is 1,00.

Then, as (1,00) is to the ſaid Periphery, ſo is the longeſt Diameter of an Ellipſis to it's Periphery.

EXAMPLE.

Let the Tranſverſe or longeſt Diameter be 50, and the ſhorteſt or Conjugate Diameter 40, as before, what's the Periphery?

As 50 : 40 : : 1,00 : ,80.

The Number in the Table anſwering to ,80 is 2,8334, which is the Periphery of an Ellipſis, whoſe longeſt Diameter is (1.) or 1,00.

Then, as 1,00 : 2,8334 : : 50,
50,
141,6700

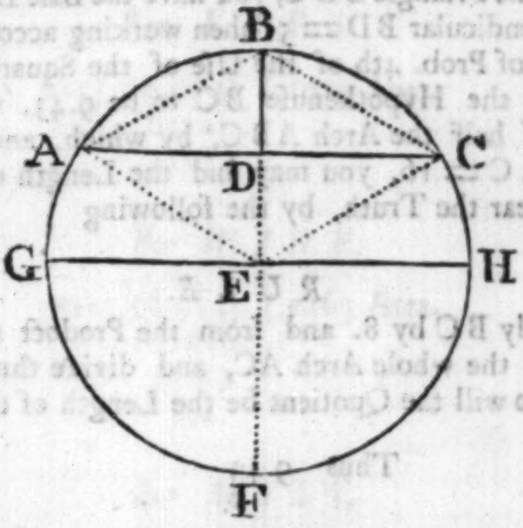
Hence we find that the Periphery required is 141 Inches, and 67 Parts of an Inch, or 100.

To Gauge the Segment of a Circle.

DEFINITION.

A Segment of a Circle is a Figure contained between a right Line A B (called a Chord) and any Part of the Circumference called an Arch, as A D B.

B



EXAMPLE.

Given the verſed Sine B D = 5 Inches, and Chord A C = 16, to find the Area of the Segment A B C.

1. Half A C = 16, is 8 = D C; and this being a Geometrical Mean between B D and D F, divide it's Square, viz. 64, by the verſed Sine B D = 5, and the Quotient
is - - - - - - - - - - 12.8 = D F.
To which add B D = - - - - 5.

The Sum is the Diameter of the Circle - - - - - } = 17.8 = B F.
Half of which is - - - - - - - 8.9 = E C = E B.
From this take the verſed Sine B D - - - - - - - - - } = 5.

And the Remainder is - - - - - 3.9 = D E, the Perpendicular of the Triangle E A C, which multiply by half A C - - - - - } = 8. = D C.

And the Product is the Area of the Triangle E A C - } = 31.2

2. In the Triangle BDC, you have the Baſe DC = 8. and the Perpendicular BD = 5; then working according to the firſt Caſe of Prob. 4th of the Uſe of the Square Root, you will find the Hypothenuſe BC to be 9.43, which is the Chord of half the Arch ABC, by which, and the given Chord AC = 16, you may find the Length of the Arch ABC, near the Truth, by the following

RULE.

Multiply BC by 8. and from the Product ſubtract the Chord of the whole Arch AC, and divide the Remainder by 3. So will the Quotient be the Length of the Arch.

Thus 9.43
8.

75.44
AC = 16.

3) ~~59.44~~ (19.81 the Length required.
~~220~~(1

3. Now the Arch Line of the Sector EABC is 19.81
Which multiply by half the Radius EC = 4.45

9905
7924
7924

The Product is the Area of the Sector 88.1545
From which take the Area of the Triangle EAC - - - - - - - - } = 31.2
The Remainder is the Area of the Segment ABC - - - - - - - - } = 56.9545 in ſquare Inches; which divide by 282 for Beer Gallons, 231 for Wine, and 2150 for Malt Buſhels.

For BEER.

282) 56,9545 (,2019 Area.
,05727
218

For WINE.

231) 56,9545 (,2465 Area.
10718(0
152(3
1(1

For MALT.

2150) 56,9545 (,0264 Area.
13954(5
105(4
1(9

Another Rule to find the Area of a Segment of a Circle.

Multiply the Square of the verſed Sine B D by .4; to the Product add the Square of half the Chord A C, and multiply the Square Root of the Sum by the ſaid verſed B D; then divide the Product by 212 ſor Beer Gallons, 173 for Wine, and 1616 for Malt Buſhels.

Let the verſed Sine B D = 5. } as before.
And Chord - - A C = 16. }

5.
5.

BD□ = 25.
.4

10.0

Half AC is = 8. and 8. × 8. = 64. add

The Sum is 74.

The Square Root of it is 8.6023
Multiply this by BD = 5.

The Product is a Dividend 43.0115

For B E E R.

212) 43,0115 (,2028 Area.
,0687(9
1(1(7

For W I N E.

173) 43,0115 (,2486
8497(7
140(3
1

For M A L T.

1616) 43,0115 (,0266
10695(9
99(5
(2

To find the Area of an irregular Superficial Figure.

Divide it into Triangles, Trapeziums, *&c.* as the Nature of the Figure will bear; then find the Contents of thoſe ſeveral Parts in Inches, and add them together; which Sum divide by 282 for Beer Gallons, 231 for Wine, and 2150 for Malt Buſhels.

EXAMPLE I.

Let ABCDEFG be an irregular Figure, whoſe Area in Beer and Wine Gallons is required; this Figure, when divided, as you ſee, is two Trapeziums, and one Triangle, whoſe Dimenſions you may alſo ſee in the ſame Figure.

Find their Areas, as you did thoſe of the Triangle and Trapezium, (at *pag.* 94 and 96) which will be

	Inches.
Area of the Trapezium FABC - -	560
Area of the Trapezium FCDE - -	480
Area of the Triangle FEG - - -	170
Their Sum is - - - - - - - - -	1210

For ***BEER.***

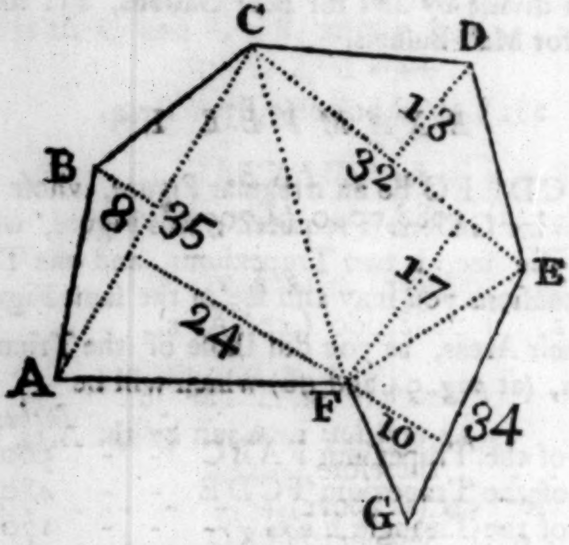
282) 1210,00(0 (4,29 Area.
0826(2
25(2
(0

For ***WINE.***

231) 1210,000 (5,238 Area.
05587(2
088(2
1(0

For MALT.

2150) 1210,0000 (,5627 Area in Malt Buſhels
135000(0
0600(5
17(9
(1



EXAMPLE II.

Let ABCDEFGHIKLMNP be an irregular Figure, which being divided into convenient Parts, and Dimenſion Lines figured as you ſee, the Content of each Part will be as under.

Here note,

That the Chord MP of the Segment MNP is 9 } Inches.
and verſed Sine PN - 4 }
That the Chord KH of the Segment KIH is 10 } Inches.
and verſed Sine QI - 6 }

Alſo,

That the Baſe MP of the Triangle MEP is 9 } Inches.
and Perpendicular Eo 14 }

The

The Area of the Triangle EPM is	63	Square Inches.
of the Trapezium EPAD	260	
of the Trapezium ABCD	154	
of the Trapezium EFGK	442	
of the Trapezium KLME	169	
Sum is	1088	

For ***BEER.***

282) 1088,0000 (3,8581 Area.

For ***WINE.***

231) 1088,0000 (4,7099 Area.

For ***MALT.***

2150) 1088,000 (,506 Area.

Theſe ſeveral Areas are more than juſt by the Area of the Segment MNP, and leſs than juſt by the Area of the Segment HIKQ, therefore,

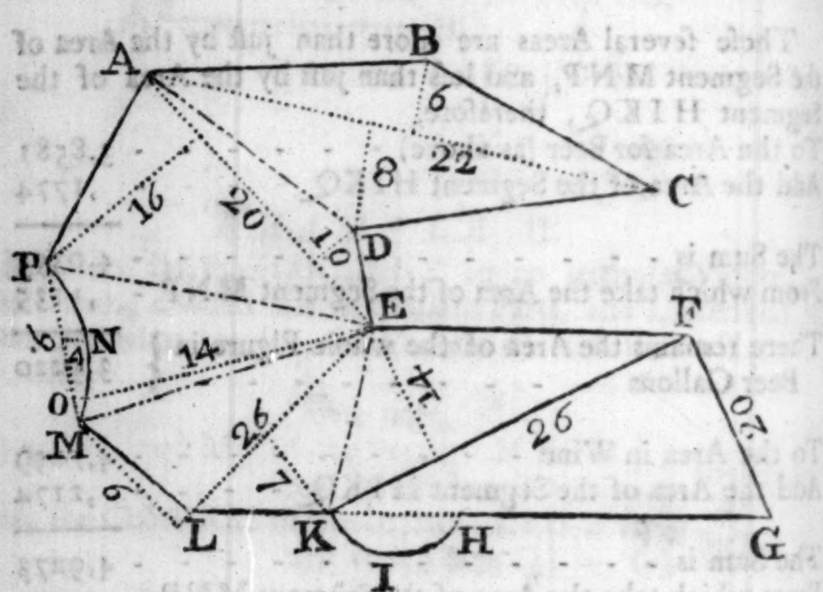
To the Area for Beer (as above)	3,8581
Add the Area of the Segment HIKQ	,1774
The Sum is	4,0355
From which take the Area of the Segment MNP	,1135
There remains the Area of the whole Figure in Beer Gallons	3,9220
To the Area in Wine	4,7099
Add the Area of the Segment HIKQ	,2174
The Sum is	4,9273
From which take the Area of the Segment MNP	,1319
There remains the Area of the whole Figure in Wine Gallons	4,7954

Again,

To the Area in Malt - - - - - - - - - -	,5060
Add the Area of the Segment HIKQ - - - -	,0232
The Sum is - - - - - - - - - - - -	,5292
From which ſubtract the Area of the Segment MNP	,0149
There remains the Area of the whole Figure in Malt - - - - - - - - - - - - -	,5143

Note, That the Area of the two Segments were found by the ſecond Rule for finding the Areas of Segments, that being near enough in Practice, and done with much leſs Trouble.

See the Figure next following.



NOTES

NOTES *upon the foregoing Examples.*

1*ſt*, That if the Sides of any Tun are parallel, and that it has any of the preceding Figures for it's Baſe; the Content of all ſuch Tuns may be found by multiplying the Area of their Baſes (found as above directed) by the Depth, and this will always hold; let the Area of the Baſe be found in what Denomination ſoever, *i. e.* whether in Feet, Inches, Ale, Wine, or Malt, *&c.*

2*dly*, That when you are to divide by 282 for Beer Gallons, and 231 for Wine, you may multiply the intended Dividend by ,0035461, and the Product will be the Content in Beer Gallons; and by ,004329, and the Product will be the Content in Wine Gallons.

3*dly*, That when you are to divide by 359 for Beer Gallons, and 294 for Wine, (as in Circles, *&c.*) you may multiply the intended Dividend by ,0027855, and the Product will be the Content in Beer Gallons; and by ,0034, and the Product will be the Content in Wine Gallons.

4*thly*, That when you are to divide by 2737,47, the Diviſor for a Circle in Malt Buſhels.

Or by 2150, the Diviſor for Squares, *&c.* you may multiply the Square of the Diameter of a Circle, or any other proper Dividend to the Diviſor, by ,0003653. And the Square of the Side of a Square, *&c.* by ,0004651, ſo will the Products be the ſame as the Quotients would have been, if the Diviſion had been made.

The Reaſons why the Multiplicators before mentioned will perform the ſame as the Diviſors, may be deduced from *Prop.* 33. *Lib.* 1. *Matheſ. Enucleata*, where it is demonſtrated, that ſimilar plane Figures are to one another in duplicate Proportion of their homologous Sides; and alſo from *Euclid*, *Prop.* 2. *Lib.* 12. where it is demonſtrated, that Circles are in the ſame Proportion as the Squares of their Diameters.

Now ſince Squares are to one another, as the Squares of their Sides; let us ſuppoſe the Side of a Square to be 1 Inch, then by the preceding Rule for that Purpoſe, the Area of ſuch a Square in Beer Gallons will be ,0035461, and in Wine ,004329; therefore as the Square of 1, *i. e.* but 1, is to it's Area, *viz.* ,0035461 in Beer, or ,004329 in Wine; ſo is the Square of the Side of any other Square, to the Area thereof in Beer or Wine. Now according to the Rule of Proportion, we ought to multiply the ſecond and third Numbers together, and divide the Product by the firſt; but becauſe in this Caſe the firſt Number is but 1, the Product muſt be the Anſwer; for 1 will neither multiply nor divide.

The ſame is to be ſaid of Circles; ſince (as above) they are to one another in the ſame Proportion as the Squares of their Diameters: if we ſuppoſe the Diameter of a Circle to be 1, then by the preceding Rule for that Purpoſe, the Area in Beer will be ,0027855, and in Wine ,0034. Therefore, as the Square of the Diameter, *viz.* 1, *i. e.* but 1, is to it's Area ,0027855 in Beer, or to ,0034 in Wine; ſo is the Square of any other Diameter to the Area of it's Circle: and here alſo, becauſe 1 is the firſt Number of the Proportion, and can't divide, the Product muſt be the Anſwer; and the ſame Reaſon ſerves for the Malt Multiplicators.

To Gauge a Cube.

DEFINITION.

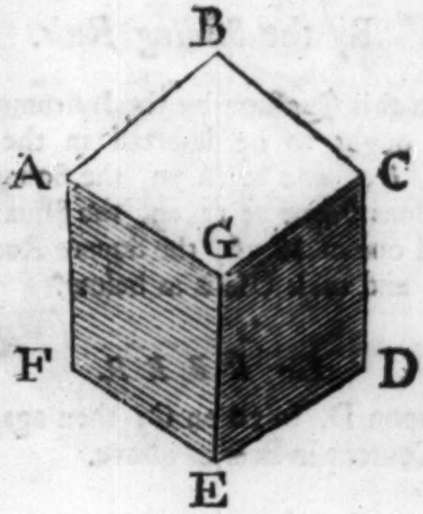
A Cube (or Dye) is a ſolid Figure contained under ſix equal Squares.

RULE.

Cube the Side, (*i. e.* multiply the Side of the Cube by itſelf, and that Product again by the Side of the Cube) then divide that cubed Number by 282 for Beer Gallons, 231 for Wine, and 2150 for Malt.

EXAMPLE.

Let ABCDEFG repreſent a Cube, whoſe Side let be 20 Inches; I demand the Content in Beer and Wine Gallons.



Side = 20
20

400 it's Square.

20
282) 8000,00 (28,36 Beer.
236443
1094
12

For WINE.

231) 8000,00 (34,63 Content in Wine.
107647
1474
00

For MALT.

2150) 8000,00 (3,720 Content in Malt.

By the *Sliding Rule.*

To perform this Queſtion by the Inſtrument at one Operation, there ought to be inſerted in the Line D three Gauge Points, *i. e.* one at 16,79, the Square Root of 282 for Beer Gallons; one at 15,19, the Square Root of 231 for Wine, and one at 46,36, the Square Root of 2150 for Malt Buſhels; and their Uſe is as below.

For BEER.

Set 16,79 upon D, to 20 on C; then againſt 20 on D, is 28,36, the Content in Beer as above.

For WINE.

Set 15,19 upon D, to 20 on C; then againſt 20 on D, is 34,63 on C, the Content in Wine as above.

For MALT.

Set 46,36 upon D, to 20 on C; then againſt 20 on D, is 3,720 on C, the Content required.

To Gauge a *Parallelopipedon.*

DEFINITION.

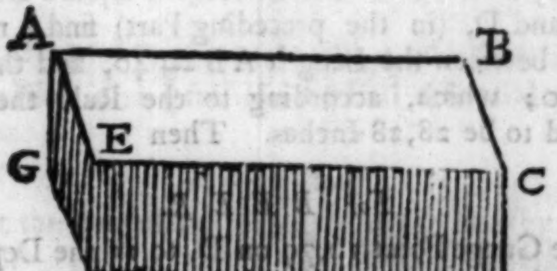
A Parallelopipedon is a ſolid Figure contained under ſix Parallelograms, the oppoſite of which are parallel.

RULE.

Multiply the Length by the Breadth, and the Product by the Depth; then divide by 282 for Beer Gallons, 231 for Wine, and 2150 for Malt Buſhels.

EXAMPLE.

Let ABCDEFG repreſent a Parallelopipedon, whoſe Length AB is 40 Inches, the Breadth BC = 20 Inches, and Depth CD = 15; what's the Content in Beer, Wine, and Malt?



For B E E R.

Length 40
Breadth 20
800
Depth 15

282) 12000,00 (42,55 Beer Gallons.
072600
1559
10

For W I N E.

231) 12000,00 (51,94 Content in Wine.
045916
2118
11

For M A L T.

2150) 120001,000 (5,581 in Malt Buſhels.

By the *Sliding Rule.*

Firſt, by *Prob.* 1. of the Uſe of the Square Root by the Lines C and D, (in the preceding Part) find a mean Proportional between the Length A B = 40, and the Breadth B C = 20; which, according to the Rule there given, you'll find to be 28,28 Inches. Then

For B E E R.

Set the Gauge Point 16,79 on D, to 15 the Depth on C; then againſt 28,28 (the Mean) on D, you'll find 42,55 on C, the Content as above.

For WINE.

Set the Gauge Point 15,19 on D, to 15 the Depth on C; then againſt 28,28 (the Mean) on D, you'll find 51,94, the Content on C.

For MALT.

Set the Gauge Point 46,36 on D, to 15 on C; then againſt 28,28 on D, is 5,581 on C, the Content required.

☞ At the End of the firſt Edition of this Book, which was printed in the Year 1707, I propoſed a Method for finding the Content of a Ciſtern, or Couch of Malt, at one Set of the Rule, without finding a Mean between the Length and Breadth as above, which till then was the only Way in Uſe; and from thence a Line, called the Reverſe Line, was taken, (as I then hoped) and marked M. D. for Malt Depths, and is much eſteemed in the Practice of Gauging; the Uſe of it is thus, Set the Length 40 upon B, to the Depth 15 upon the Line M. D; then againſt the Breadth 20 upon A, you'll find 5,581 upon B, as before; and ſo for any other.

To Gauge a Priſm.

DEFINITION.

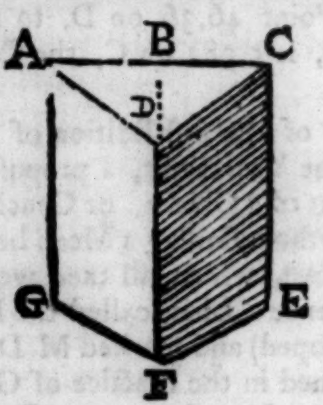
A Priſm is a ſolid Figure, the two oppoſite Ends of which are equal, alike, and parallel; and all other Sides are Parallelograms.

RULE.

Multiply the Baſe of the Triangle at the End by half the Perpendicular, then multiply that Product by the Depth, and divide the laſt Product by 282 for Beer, 231 for Wine, and 2150 for Malt.

EXAMPLE.

Let ABCDEFG repreſent a Triangular Priſm, (for there are diverſe Sorts of them, but all take their Denomination from their Baſes or Ends) let AC be 40 Inches, BD = 22 Inches, and the Depth AG = 60; what's the Content in Beer and Wine Gallons, and Malt Buſhels?



For BEER.

AC = 40
Half BD = 11

440
Depth 60

282) 26400,00 (93,61 Content in Beer Gall.
102488
1749
01

For WINE.

231) 26400,00 (114,28 Content in Wine Gall.
0339682
09693
011

For MALT.

2150) 26400,00 (12,27 Content in Malt.

By the *Sliding Rule.*

Firſt find a mean Proportional between half B D = 11, and A C = 40; which by the Sliding Rule is 20,97. Then

For BEER.

Set the Gauge Point 16,79 on D, to 60 on C; then againſt 20,97 on D, is 93,61 on C, the Content as above.

For WINE.

Set the Gauge Point 15,19 on D, to 60 on C; then againſt 20,97 on D, is 114,28 on C, as above.

For MALT.

Set the Gauge Point 46,36 on D, to 60 on C; then againſt 20,97 on D, is 12,27 on C, the Content as above.

Or, Set the Depth 60 upon B, to half the Perpendicular B D, which is 11 upon M. D; then againſt 40 upon A, you'll have 12,27, as before.

To Gauge a Cylinder.

DEFINITION.

A Cylinder is a ſolid Figure, riſing from a circular Baſe (or Circle) in right Lines, and ending in an equal Circle, or it is like the Rolling-ſtone of a Garden.

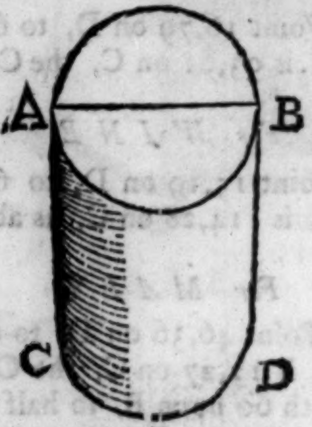
RULE.

RULE.

Square the Diameter, and multiply that Square by the Depth; then divide by 359 for Beer Gallons, 294 for Wine, and 2737,47 for Malt Buſhels.

EXAMPLE.

Let A B C D repreſent a Cylinder; and let A B (the Diameter) be 40 Inches, and A C the Depth = 60; what's the Content thereof in Beer, Wine, and Malt?



The Diameter 40 = A B
40

it's Square = 1600
the Depth A C = 60

Product 96000 which divide by the proper Diviſors.

For BEER.

359) 96000,000 (267,409 Content.
24267409
264346
1031

For W I N E.

294) 96000,000 (326,530 Content.
07826080
195928
1002

For M A L T.

2737,47) 96000,000 (35,068 Content.

By the *Sliding Rule.*

Upon the Line D you have three Gauge Points ; the firſt mark'd with *W.g.* for Wine Gallons, the ſecond with *A.g.* for Ale Gallons, and the third with *M.G.* for the Malt Gauge Point ; their Uſe is as below.

For B E E R.

Set *A.g.* = 18,94 on D, to the Depth 60 upon C ; then againſt the Diameter = 40 on D, you'll find 267,409, as above.

For W I N E.

Set *W.g.* = 17,14 on D, to the Depth = 60 on C ; then againſt the Diameter 40 on D, you'll find 326,530, as above.

For M A L T.

Set *M.g.* = 52,32 on D, to 60 the Depth on C ; then againſt 40 on D, is 35,068 on C, for the Content, as above.

To Gauge a Cone.

D E F I N I T I O N.

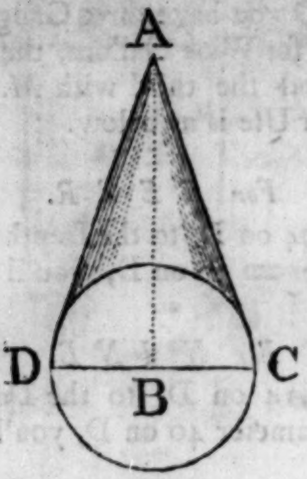
A Cone is a ſolid Figure, riſing from a circular Baſe (CD) in right Lines (CA DA) and ending in a Point (A) which is called the Vertex or Top.

RULE.

Square the Diameter, and multiply that Square by the Height; then divide by 1077 for Beer Gallons, 882 for Wine, and 8212,41 for Malt Buſhels.

EXAMPLE.

Let ABCD be a Cone, whoſe Heighth AB is 60 Inches, and Diameter DC 40; I demand the Content in Beer, Wine, and Malt?



Diameter DC =	40
	40
it's Square	1600
the Heighth	60

the Square of the Diameter in the Heighth 96000, which divide by 1077, by 882, and by 8212,41; for Beer, Wine, and Malt, as in the next Page.

For

For BEER.

1077) 96000,000 (89,136 the Content.
09847398
014992
0365
00

For WINE.

882) 96000,000 (108,843 Content.

For MALT.

8212,41) 96000,00 (11,68 Content.

By the *Sliding Rule.*

For BEER.

Set the Gauge Point *A. g.* = 18,94 on D, to one third of the Heighth, *i. e.* 20 on C; then againſt the Diameter, *viz.* 40 on D, you'll have 89,136, as above.

For WINE.

Set the Gauge Point *W. g.* on D, (*viz.* 17,14) to 20 (= $\frac{1}{3}$ of 60) on C; then againſt the Diameter, *viz.* 40 on D, you'll find 108,843 upon C, as above.

For MALT.

Set the Gauge Point *M. g.* (52,32) on D, to 20 (= $\frac{1}{3}$ of 60) on C; then againſt the Diameter, *viz.* 40 on D, is 11,68 on C, as above.

To Gauge a Square Pyramid.

DEFINITION.

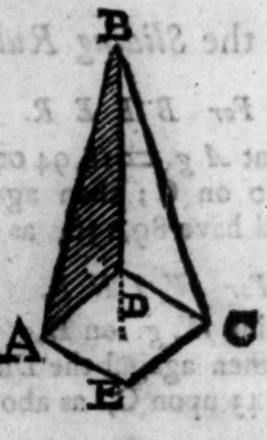
A Square Pyramid is a ſolid Figure, whoſe Sides are plain Triangles, and, ariſing from a Square Baſe, meet in one Point at B.

RULE.

Square the Side, and multiply that Square by the Heighth; then divide by 846 (= 3 Times 282) for Beer Gallons, 693 (= 3 Times 231) for Wine, and 6451,26 (= 3 Times 2150,42) for Malt Buſhels.

EXAMPLE.

Let A B C D E repreſent a Square Pyramid, whoſe Side let be 40 Inches, and Heighth 60; what's the Content in Beer, Wine, and Malt?



The Side AE = CE = DC = 40 Inches.

	40
It's Square is	1600
Which multiply by	60

and the Product 96000 is a Dividend, which if you divide by 846, 693, and 6451,26 (as by the Rule) the Quotients will be the Content in Beer, Wine, and Malt.

For

For B E E R.

846) 96000,000 (113,475 Content.
11442680
290335
4641

For W I N E.

693) 96000,000 (138,528 Content.
26716546
596969
3150

For M A L T.

6451,26) 96000,000 (14,88 Content.

By the *Sliding Rule.*

For B E E R.

Set 16,79 (the Gauge Point for a Square in Beer Gallons) on D, to 20 (= $\frac{1}{3}$ of 60) upon C; then againſt 40 (the Side given) on D, is 113,475, for the Content in Beer Gallons and Parts, as above on C.

For W I N E.

Set 15,19 (the Gauge Point for a Square in Wine Gallons) on D, to 20 (= $\frac{1}{3}$ of 60) upon C; then againſt the given Side, *viz.* 40 on D, you'll find 138,528, the Content in Wine Gallons and Parts, as above on C.

For M A L T.

Set 46,36 (the Malt Gauge Point for a Square) on D, to 20 (= $\frac{1}{3}$ of 60) on C; then againſt the given Side, *viz.* 40 on D, you'll find 14,88 on C, the Content in Malt Buſhels and Parts, as above.

To Gauge a Parabolick Conoid.

DEFINITION.

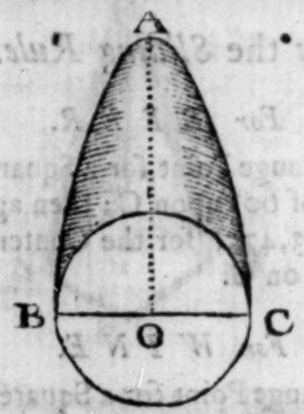
A Parabolick Conoid is made up of an infinite Number of Circles, whoſe Area's are in Arithmetick Progreſſion, and formed by the Rotation of a Semi-parabola, *&c.*

RULE.

Multiply the Square of the Diameter by the Heighth, and divide the Product by 718 for Beer Gallons, 588 for Wine, and 5474,94 for Malt Buſhels.

EXAMPLE.

Let ABC be a Parabolick Conoid, whoſe Diameter BC is 40 Inches, and Heighth AO 60; what's the Content thereof in Beer and Wine Gallons, and Malt Buſhels?



DEFINITION.

The Diameter BC is 40 Inches.
40
it's Square is 1600
the Heighth AO is 60

the Rectangle of the Heighth in the Square of the Diameter - - - - - - } 96000, which divide according to the Rule, as in the next Page.

For

For *BEER.*

718) 96000,000 (133,704 Content.
24266408
260342
5035

For *WINE.*

588) 96000,000 (163,265 Content.
37226420
195818
1331

For *MALT.*

5474,94) 96000,000 (17,53 Anſwer.

By the *Sliding Rule.*

For *BEER.*

Set 18,94 (the Beer Gauge Point for a Circle) on D, to 30 (*i. e.* one Half of the Heighth, *viz* 60) on C; then againſt 40 (the Diameter) on D, you'll find 133,704, the Content in Gallons and Parts on the Line C.

For *WINE.*

Set 17,14 (the Gauge Point for a Circle in Wine Gallons) on D, to 30 (*i. e.* half the Heighth, *viz.* 60) on C; then againſt the Diameter, *viz.* 40 on C, you'll find 163,265, the Content required on C.

For *MALT.*

Set 52,32 (the Malt Gauge Point for a Circle) on D, to 30 (*i. e.* half the Heighth, *viz.* 60) on C; then againſt 40 (the Diameter) on D, you'll find 17,53 the Content required on C.

To Gauge an Hyperbolick Conoid.

DEFINITION.

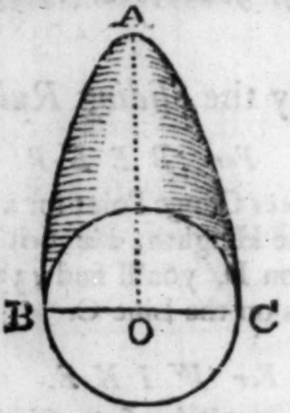
An Hyperbolick Conoid is made by the Rotation of a Semi-hyperbola about it's Axe.

RULE.

Multiply the Square of the Diameter by the Heighth, and then divide that Product by 862 for Beer Gallons, by 706 for Wine, and 6569,9 for Malt Buſhels.

EXAMPLE.

Let ABOC repreſent a Hyperbolick Conoid, whoſe Heighth AO let be 48 Inches, and Diameter BC 26; what's the Content in Beer and Wine Gallons, and Malt Buſhels?



The Diameter BC is 26 Inches.
26
156
52
It's Square is 676
48 = Heighth.
5408
2704
The Rectangle of the Square of the Diameter and Heighth is - - } 32448

For BEER.

862) 32448,00 (37,64 Content.
658482
5563
32

For WINE.

706) 32448,00 (45,96 Content.
420864
6722
40

For MALT.

6569,9) 32448,00 (4,938 Content.

By the *Sliding Rule.*

For BEER.

Set 29,36 (the Beer Gauge Point for a Hyperbolick Conoid) on D, to the Heighth, *viz.* 48 Inches on C; then against 26 (the Diameter) on D, you'll find 37,64 on C, as above.

For WINE.

Set 26,57 (the Wine Gauge Point for a Hyperbolick Conoid) on D, to the Heighth, *viz.* 48 Inches on C; then against the Diameter, *viz.* 26 on D, you'll find 45,96, the Content required on C.

For MALT.

Set 81,05 (the Malt Gauge Point for a Hyperbolick Conoid) on D, to 48 on C; then against 26 on D, you'll find 4,938, the Content in Buſhels and Parts, as above.

To Gauge a Spheroid.

DEFINITION.

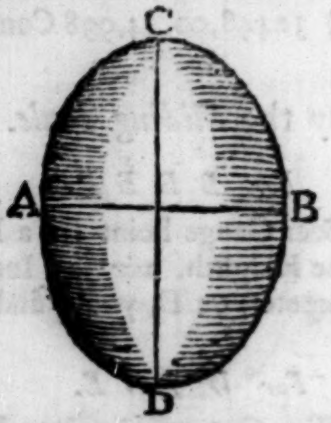
A Spheroid is an oval Solid, longer than it is broad or deep, being made by the Rotation of a Semi-Ellipſis.

RULE.

Multiply the Square of the Conjugate by the tranſverſe Diameter; then divide the Product by 538 for Beer Gallons, 441 for Wine, and 4106,2 for Malt.

EXAMPLE.

Let ABCD be a Spheroid, whoſe conjugate Diameter AB is 42 Inches, and tranſverſe Diameter CD 60; I demand the Content in Beer, Wine, and Malt.



The Conjugate (or ſhorteſt) Diameter, *viz.* AB is	42
	42
	84
	168
It's Square is	1764
The Tranſverſe (or longeſt) Diameter is DC =	60
The Dividend is	105840

Which if you divide by the Diviſors as in the Rule, you'll have the Content of the Spheroid in Beer and Wine Gallons, and Malt Buſhels.

For

For B E E R.

538) 105840,00 (196,72 the Content in Beer Gallons and Parts.
5202244
36956
314

For W I N E.

441) 105840,00 (240 the Content in Wine Gallons.
17600
000

For M A L T.

4106,2) 105840,00 (25,77 the Content in Buſhels and Parts.

By the *Sliding Rule.*

For B E E R.

Set 23,19 (the Beer Gauge Point for a Spheroid) on D, to the tranſverſe Diameter, *viz.* 60 on C; then againſt the conjugate Diameter, *viz.* 42 on D, you'll find 196,72 on C, the Content required as above.

For W I N E.

Set 21 (the Wine Gauge Point for a Spheroid) on D, to the tranſverſe Diameter, *viz.* 60 on C; then againſt 42 on D, you'll find 240 on C, for the Content as above.

For M A L T.

Set 64,07 on D, to 60 on C; then againſt 42 on D, is 25,77 the Content required on C.

To Gauge a Globe.

DEFINITION.

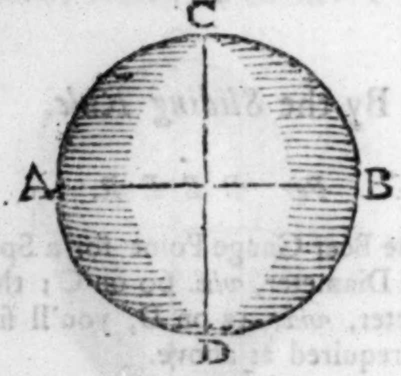
A Sphere or Globe is a round Solid, whoſe Length, Breadth, and Depth, is alike or equal.

RULE.

Cube the Globe's Diameter; then divide that Cube by 538 for Beer Gallons, 441 for Wine, and 4106,2 for Malt Buſhels.

EXAMPLE.

Let ABCD repreſent a Globe, whoſe Diameter AB or CD is 36 Inches; I demand the Content in Beer and Wine Gallons, and Malt Buſhels.



The Diameter AB = CD is	36 Inches.
	36
	216
	108
It's Square is	1296
	36
	7776
	3888
It's Cube for a Dividend is	46656

For BEER.

538) 46656, (86,72 the Content in Beer Gallons and Parts.
36184
386

For WINE.

441) 46656,00 (105,79 the Content in Wine Gallons and Parts.
0255131
25526
342

For MALT.

4106,2) 46656,0000 (11,36 the Content in Buſhels and Parts.

By the *Sliding Rule.*

For BEER.

Set 23,19 upon D, to 36 upon C; then againſt 36 on D, you'll find 86,72 on C, the Content required.

For WINE.

Set 21 on D, to 36 on C; then againſt 36 on D, you'll find 105,79 on C, the Content required.

For MALT.

Set 64,07 on D, to 36 on C; then againſt 36 on D, you'll find 11,36 on C, the Content required; where you may obſerve, that the ſame Diviſor and Gauge Point ſerves both the Globe and Spheroid, they being the ſame Part of their circumſcribing Cylinder.

The Diviſors for a Cylinder being for Ale Gallons 359,
for Wine - - 294,
and for Malt - - 2737,47;
And the Gauge Points upon the Line D, being the Square Roots of thoſe Diviſors, *viz.* for Beer or Ale - 18,94
for Wine - - 17,14
and for Malt Buſhels 52,32

Now a Cone being $\frac{1}{3}$ of a Cylinder, if you multiply the Square of the Diameter of a Cone by $\frac{1}{3}$ of the Heighth, you may divide the Product by the ſame Diviſors as you did for the Cylinder, and alſo uſe the ſame Gauge Points.

The ſame Diviſors and Gauge Points will ſerve for a Parabolick Conoid, if you multiply the Square of the Diameter by half the Heighth.

For an Hyperbolick Conoid, by $\frac{5}{12}$ of the Heighth.

For a Spheroid, by multiplying the Square of the conjugate Diameter, by $\frac{2}{3}$ of the tranſverſe Diameter. And,

For a Sphere, by multiplying the Square of the Diameter by $\frac{2}{3}$ of the ſame.

To Gauge an elliptick Cone.

DEFINITION.

An elliptick Cone is a ſolid Figure, ariſing from an elliptical Baſe in ſtraight Lines, and ending in a Vertex or Point as A.

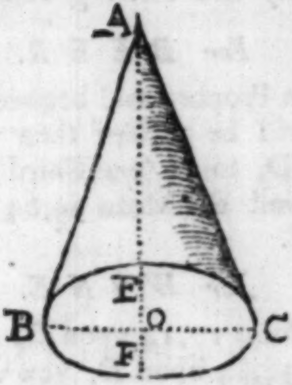
RULE.

Multiply the Rectangle of the Bottom Diameters by the Heighth; then divide by 1077 for Beer Gallons, 882 for Wine, and 8212,41 for Malt Buſhels.

EXAMPLE.

Let BACO repreſent an upright elliptick Cone; the conjugate Diameter of it's Baſe is 30 Inches, the Tranſverſe

40, and Height A O 60; what's the Content in Beer, Wine, and Malt?



The tranſverſe Diameter B C is - - 40 Inches.
The conjugate Diameter E F is - - 30

Their Rectangle is - - - - - 1200
Which, multiply'd by the Altitude A O = 60, gives - } 72000 for a Dividend.

For B E E R.

1077) 72000,00 (66,85 the Content in Beer Gallons and Parts.
0738845
09165
052
0

For W I N E.

882) 72000,00 (81,63 the Content in Wine Gallons and Parts.
144884
5583
22

For M A L T.

8212,41) 72000,0000 (8,767 the Content in Malt Buſhels and Parts.

By

By the *Sliding Rule.*

For BEER.

Firſt find a Mean Proportional between the Diameters 30 and 40, which will be 34,64; then ſet the Beer Gauge Point 18,94 upon D, to 20 (one Third of the Heighth 60) upon C; and againſt the Mean 34,64 upon D, you will find 66,85 upon C.

For WINE.

Set the Gauge Point 17,14 upon D, to 20 upon C; then againſt the Mean 34,64 upon D, you will have 81,63 upon C.

For MALT.

Set the Gauge Point 52,32 upon D, to 20 upon C; then againſt the Mean 34,64 upon D, you will find 8,767 upon C.

To Gauge the Fruſtum of a Cone.

DEFINITION.

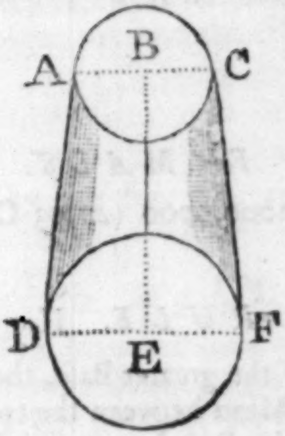
If a Cone, Conoid, or Pyramid, be cut by a plain Parallel to the Baſe; that which remains below, is called the Fruſtum of a Cone, Conoid, *&c.*

RULE I.

To three Times the Rectangle of the Diameters, add the Square of their Difference, multiply the Sum by the Depth, and divide by 1077 for Beer Gallons, 882 for Wine, and 8212,41 for Malt Buſhels.

EXAMPLE.

Let ABCDEF repreſent the Fruſtum of a Cone; let the Top Diameter, *viz.* AC, be 30 Inches, the Bottom Diameter DF 40 Inches, and the Depth BE 60 ; what's the Content in Beer and Wine Gallons, and Malt Buſhels?



For BEER.

The Bottom Diameter is	40 Inches.
The Top Diameter is	30
Their Rectangle is	1200
	3
Three times the Rectangle or Product is	3600
The Sq. of the Difference of the Diameters is	100
The Sum is	3700
The Depth is	60
The Dividend is	222000

1077) 222000,00 (206,12 the Content in Beer Gallons and Parts.
00660836
66307
0138
00

For

For WINE.

882) 222000,000 (251,700 Content in Wine Gallons and Parts.
4560860
15106
600

For MALT.

8212,41) 222000,0000 (27,03 Content in Malt Buſhels.

RULE. II.

Take the Area of the greater Baſe, the Area of the leſſer, and a Geometrical Mean between the two Area's; the Sum of theſe three, multiplied by one third Part of the Tun's Depth, gives the Content: And this is a general Rule for the Fruſtum of any Pyramid, whoſe Baſes are parallel, whether they are ſquare, triangular, circular, *&c.*

EXAMPLE.

Let the Tun be the ſame as above, whoſe Top Diameter is 30 Inches, the Bottom 40, and the Depth 60; what's the Content in Beer, Wine, and Malt?

The Area of the Top Diameter (*viz.* 30) is	2,5069
The Area of the Bottom Diameter (*viz.* 40) is	4,4568
The Mean between the two Area's is	3,3425
Their Sum is	10,3062
This Sum, *viz.* 10,3062, muſt be multiplied by	20
The Content required in Beer Gallons and Parts	206,1240

For WINE.

The Area of the Top Diameter (*viz.* 30) is	3,0612
The Area of the Bottom Diameter (*viz.* 40) is	5,4421
The Geometrical Mean between the two Areas is	4,0815
Their Sum is	12,5848
	20
Which multiplied by $\frac{1}{3}$ of 60, *viz.* 20, gives the Content. - - - - - - - - - - -	251,696

For MALT.

The Area of the Top Diameter (*viz.* 30) is	0,3287
The Area of the Bottom Diameter (*viz.* 40) is	0,5845
The Geometrical Mean between the two Areas is	0,4384
Their Sum is	1,3516
Which being multiplied by $\frac{1}{3}$ of the Height, 60, *i. e* 20, will give the Content in Buſhels and Parts. - - - - - - - - - - - - -	20 27,032

By the *Sliding Rule.*

For BEER.

Set 18,94 (the Beer Gauge Point for a Circle) on D, to 1 upon C; then againſt any Diameters on D, is the Area on C.

Thus againſt 30 on D, you'll find it's Area	2,5069
And againſt 40 on D, it's Area	4,4568
Then (by *Prob.* 1. in the Uſe of the Square Root by the Rule before-going) find a Mean between the Areas. - - - - - - - - - - - -	3,3425
Their Sum is	10,3062

Which by the Lines A and B, multiply by 20, and the Product will be 206,1240, as above.

For WINE.

Set 17,14 on D, to 1 on C; then againſt 30 on D, is - - - - - - - - - - - - -	3,0612
And againſt 40 on D, you'll find	5,4421
The mean Proportion between theſe two Areas is	4,0815
Their Sum is	12,5848

Then ſet 1 upon B, to 12,5848 on A; and againſt 20 on B, you'll find 251,6960, as above; and the ſame muſt be obſerved for Malt, Reſpect had to the proper Gauge Point.

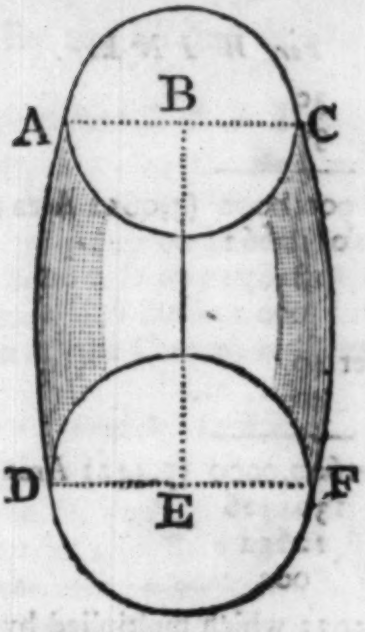
To Gauge the lower Fruſtum of a parabolick Conoid, cut parallel to the Baſe.

RULE.

Add the Areas of the Diameters together, and multiply that Sum by half the Heighth; ſo is the Product the Content of ſuch a Tun.

EXAMPLE II.

Let ABCDEF repreſent the lower Fruſtum of a parabolick Conoid, whoſe Top Diameter is 30 Inches, the Bottom Diameter 40, and the Depth 60; what's the Content of the Tun in Beer and Wine Gallons, and Malt Buſhels?



For *B E E R.*

Top Diameter 30
30

359) 900,0000 (2,5069 Area of the Top Diameter.
1825069
02542
232

Bottom Diameter 40
40

359) 1600,0000 (4,4568 Area of the Bottom Diameter.
1644568
20498
220

The Sum of the two Areas is 6,9637 which multiplied by Half the Depth (*viz.* 60) *i.e.* 30 gives the Content of the Tun, *viz.* 208,9110 in Beer Gallons and Parts.

For WINE.

Top Diameter 30
30
294) 900,0000 (3,0612 Area of the Top Diameter.
0110662
18367
000
Bottom Diameter 40
40
294) 1600,0000 (5,4421 Area of the Bottom.
1304426
12652
002

The Sum is 8,5033 which multiplied by half the Depth, (*viz.* 60) *i.e.* 30 produceth the Content of the Tun
255,0990 in Wine Gallons and Parts.

For MALT.

Top Diameter 30
30
2737,47) 900,000000 (,3287 the Area of the Top.
Bottom Diameter 40
40
2737,47) 1600,0000 (,5845 the Area of the Bottom.

The Sum of the Areas is ,9132 which multiplied by half the Depth (*viz.* 60) *i.e.* 30 shews the Content of the Tun to be 27,3960 Malt Bushels and Parts.

By

By the *Sliding Rule.*

For BEER.

Set 18,94 on D, to 1 upon C; then againſt 30 on D, is 2,5069, the Area of the Top Diameter on C; and as the Rule is now ſet, againſt 40 on D you'll find 4,4568 on C, the Area of the Bottom Diameter; then ſet 1 upon B, to 30 on A, and then againſt the Sum of the Areas on B, you'll find 208,9110 on A, the Content as above.

For WINE.

Set 17,14 on D, to 1 on C; then againſt the Diameters, *viz.* 30 and 40 on D, you'll find 3,0612 and 5,4421 their Areas on C; then ſet 1 on B, to 30 on A, and againſt the Sum of the Areas, *viz.* 8,5033 on B, is 255,0990, the Content required on A.

For MALT.

Set 52,32 on D, to 1 on C; then againſt 30 and 40 on D, you'll find ,3287 and ,5845 on C, their Areas; then ſet 1 on B, to 30 on A, and againſt ,9132 (the Sum of the Areas) on B, you'll find 27,3960 on A, as above.

RULE II.

Multiply the Sum of the Squares of the Diameters by the Depth, and divide the Product by 718 for Beer Gallons, 588 for Wine, and 5474,94 for Malt Buſhels.

EXAMPLE.

Let the Top Diameter be 20 Inches, the Bottom 30, and the Depth 40; what's the Content in Beer and Wine Gallons, and Malt Buſhels?

For B E E R.

Top Diameter 20 Bottom Diameter 30
20 30

It's Square 400 It's Square 900
400

The Sum of the Square is 1300
40

718) 52000,00 (72,42 Anſw.
17448(4
306(4
1(2

For W I N E.

588) 52000,00 (88,43 Content in Wine Gallons and Parts.
496686
2501
23

The ſame Dividend being divided by 5474,94 will quote the Content in Buſhels; and the like for the Fruſtum of any other parabolick Conoid.

To find the Content of any Tun, whoſe Sides are ſtraight, and Baſes Parallelograms or Ellipſes.

RULE.

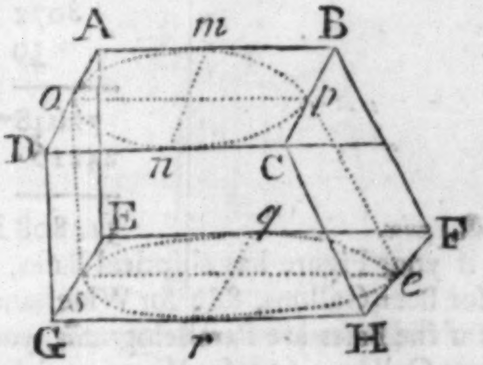
1. To the greateſt Length *se*, add Half the leſſer Length *op*; then multiply the Sum by the greater Breadth *qr*, reſerving that Product.

2. To the leſſer Length *op*, add Half the greater Length *se*; and multiply the Sum by the leſſer Breadth *mn*, add this Product to that before reſerved; then multiply the Sum

by the Depth, and divide the Product by 846 for Beer Gallons, and 693 for Wine, if the Baſes were Parallelograms; but by 1077 for Beer Gallons, 882 for Wine, and 8212,41 for Malt, if they were Ellipſes.

EXAMPLE.

Let ABCDEFGH repreſent a Tun, whoſe Baſes are Parallel and Sides ſtraight, in which the ſtraight Lines at the Top and Bottom may repreſent a Tun, whoſe Baſes are Parallelograms, and the curved Lines may ſignify the Fruſtum of an elliptick Cone as below.



Let the Length of the greater Baſe of the Tun, *viz.* EF = *se* = GH be 60 Inches, and the Breadth of the ſame Baſe, *viz.* EG = *qr* = FH be 30 Inches; let the Length of the leſſer Baſe be DC = *op* = AB = 52 Inches, the Breadth of the ſame Baſe, *viz.* AD = *mn* = BC = 46, and the Depth DG = *os* = &c. 39; what's the Content in Beer, Wine, and Malt?

The greater Length, *i. e.* EF = &c. is	60 Inches.
Half the leſſer Length, *viz.* DC = *op*, &c. = 52, is - - - - - - - - - - -	26
Their Sum is	86
Greater Breadth, *viz.* GE = *rq* = &c. is	50
The Product to be reſerved is	4300

The leſſer Length, *viz.* AB = *o p*, &c. is 52
Half the greater Length, *viz.* EF = &c. is 30

Their Sum is 82
Leſſer Breadth AD = *m n* = &c. is 46

492
328

The Product is 3772
The Product above reſerved is 4300

Their Sum is 8072
The Depth is 39

72648
24216

This Product, *viz.* 314808 is your Dividend. Now if your Figure has elliptical Baſes, your Diviſors are 1077 for Beer Gallons, 882 for Wine, and 8212,41 for Malt. But if the Baſes are Parallelograms, your Diviſors are 846 for Beer Gallons, 693 for Wine, and 6451,26 for Malt.

To Gauge the Fruſtum of an upright elliptick Cone, cut parallel to the Baſe another Way.

RULE.

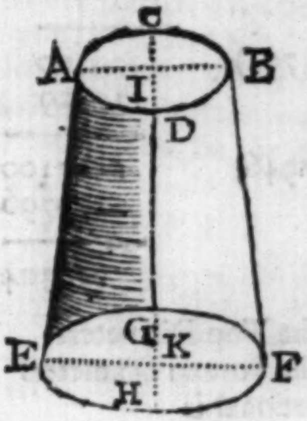
Multiply the Product of the Top Diameters by the Product of the Bottom Diameters, and extract the Square Root of that Product, which Root add to the Sum of the ſaid Products; multiply the laſt Sum by the Depth, then divide by 1077 for Beer Gallons, 882 for Wine, and 8212,41 for Malt Buſhels.

EX-

EXAMPLE.

Let ABCDEFGHIK repreſent the Fruſtum of an upright elliptick Cone, whoſe Dimenſions are as below.

Greateſt Diameter at the Top A B is - -	40	What's the Content in Beer, Wine, and Malt?
Leaſt Diameter at the Top C D is - -	30	
Greateſt Diameter at the Bottom E F -	60	
Leaſt Diameter at Bottom G H - - -	50	
Depth I K - - - - - - - - - - -	66	



The greateſt Diameter at the Top is		40
Leaſt Diameter at the Top is		30
Their Rectangle or Product is		1200
The greateſt Diameter at the Bottom is		60
The leaſt Diameter at the Bottom is		50
Their Rectangle or Product is		3000
Rectangle of the Top Diameter is	1200	
Rectangle of the Bottom Diameter is	3000	

Their Product is 3600000,0000 (1897,36 Root.

1

2) 260
224

36) 3600
3321

378) 27900
26509

3794) 139100
113829

37946) 2527100
2276796

250304

Rectangle of the Top Diameters 1200
Rectangle of the Bottom Diameters 3000
A mean Proportional is 1897,36

Their Sum is 6097,36
Their Depth is 66

3658416
3658416

The Dividend is 402425,76

For B E E R.

1077) 402425,76 (373,65 Content in Beer Gallons and Parts.
07933451
039087
0753
00

For

For WINE.

882) 402425,76 (456,26 the Content in Wine Gallons and Parts.
4962334
55374
354

For MALT.

8212,41) 402425,76 (49,00 Content in Buſhels and Parts.

2. Or (according to the general Rule before given for the Fruſtum of a Cone) you may find the Area of the greater Baſe, the Area of the leſſer Baſe, and a mean Proportional between them; and then multiply the Sum of theſe by $\frac{1}{3}$ of the Heighth, ſo will the Product be the Anſwer.

EXAMPLE.

Let the Figure and Dimenſions be the ſame as in the firſt Caſe; what's the Area in Beer, Wine, and Malt?

For BEER.

As 359 is to 30, ſo is 40 to 3,3426 the Area of the Top Diameter.
30

359) 1200,0000 (3,3426
1233426
15926
020

As 359 is to 50, ſo is 60 to 8,3565 the Area of the Bottom Diameter.
60

359) 3000,0000 (8,3565
1283565
20396
211

Area

Area of the Top	3,3426
Area of the Bottom	8,3565
A Mean	5,2851
Their Sum is	16,9842
One Third of the Heighth	22
	339684
	339684
Content of the Tun (near that above) is	373,6524

For WINE.

1. As 294 is to 30, ſo is 40 to 4,0816 Area of the Top Diameter.

2. As 294 is to 50, ſo is 60 to 10,2040 Area of the Bottom.

The Geometrical Mean is	6,4536	
The Sum is	20,7392	which multiply
by $\frac{1}{3}$ of the Heighth (*viz.* 66) *i. e.*	22	and the Product
	414784	
	414784	
will be	456,2624	the Cont. required.

For MALT.

1. As 2737,47 is to 30, ſo is 40 to ,4383 the Area at the Top.

2. As 2737,47 is to 50, ſo is 60 to 1,0959 the Area at the Bottom.

The Geometrical Mean is	,6903	
The Sum is	2,2245	which multiply
by $\frac{1}{3}$ of the Heighth (*viz.* 66) *i. e.*	22	and the Product
will be	48,939	the Cont. required.

By

By the *Sliding Rule.*

For BEER.

1. Set 359 on B, to 30 on A; then againſt 40 on B, is 3,3426 (the Area at the Top) on A.

2. Set 359 on B, to 50 on A; then againſt 60 on B, is 8,3565 (the Area of the Bottom) on A.

3. Then ſet 3,3426 on C, to 3,3426 on D; then againſt 8,3565 on C, is 5,2851 on D, for a mean Proportional; all which add to the two Areas before found, and their Sum is 16,9842; which (by the Rule) multiplied by 22, gives 373,6, *&c.* the Content.

To find the Content in Wine Gallons.

1. Set 294 on B, to 50 on A; then againſt 40 on B, is 4,0816 (the Area of the Top) on A.

2. Set 294 on B, to 50 on A; then againſt 60 on B, is 10,2040 (the Area of the Bottom) on A.

3. Set 4,0816 on the Line C, to 4,0816 on D; then againſt 10,2040 on C, is 6.4536 (a Geometrical Mean between the two Areas) on D, which add to the ſaid Areas, and the Sum will be 20,7392.

4. Set 1 upon B, to ⅓ of the Heighth (*viz.* 66) 22 on A; then againſt 20,7392 on B, is 456,2624 (the Content required) on A.

For MALT.

1. Set 2737,47 on B, to 30 on A; then againſt 40 on B, is the Area of the Top on A, *viz.* - ,4383

2. Set 2737,47 on B, to 50 on A; then againſt 60 on B, is the Area of the Bottom on A, *viz.* 1,0959

3. Set ,4383 on C, to ,4383 on D; then againſt 10,959 on C, is the Mean on D, *viz.* - - ,6903

The Sum is - - - - - - - - - - - - - - 2,2245

4. Set 1 on B, to 2,2245 on A; then againſt ,22 on B, is 48,939, the Content of the Tun in Buſhels required on A: And the like may be done with a Tun, whoſe Baſes are Parallelograms, and it's Sides ſtraight; only inſtead of the former Diviſors, you muſt make Uſe of 282 for Beer Gallons, 231 for Wine, and 2150 for Malt Buſhels.

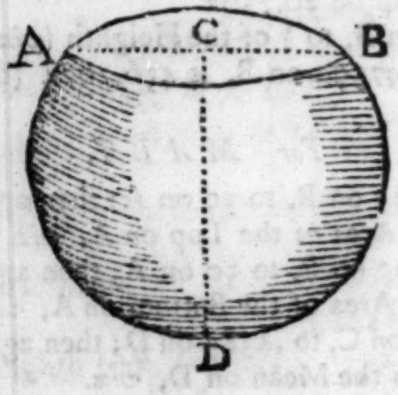
To Gauge the Fruſtum of a Globe.

RULE.

To the Area of the Fruſtum's Diameter, add the Area of the Heighth, more one Third of the ſame; multiply the Sum by half the Heighth, and the Product will be the Content of the Fruſtum.

EXAMPLE.

Let ABCD repreſent the Fruſtum of a Globe, whoſe Diameter AB let be 28 Inches, and Altitude or Depth CD 30; what's the Content of the Fruſtum in Beer and Wine Gallons, and Malt Buſhels?



For

For BEER.

1. As 359 is to 28, ſo is 28 to the Area of the Diameter, *i. e.* - - - - - - - - - - -	2,1838
2. As 359 is to 30, ſo is 30 to the Area of the Depth, *i. e.* - - - - - - - - - - - -	2,5069
One Third of the Area of the Height is	0,8356
Their Sum is	5,5263
Half the Altitude or Depth is	15
	276315
	55263
The Content of the Fruſtum is	82,8945

For WINE.

1. As 294 is to 28, ſo is 28 to the Area of the Diameter, *i. e.* - - - - - - - - - - -	2,6666
2. As 294 is to 30, ſo is 30 to the Area of the Depth, *i. e.* - - - - - - - - - - - - -	3,0612
One Third of the Area of the Altitude (*viz.* 30) is - - - - - - - - - - - - - - -	1,0204
Their Sum is	6,7482
Half the Depth (30) is	15
	337410
	67482
The Content of the Fruſtum in Wine Gallons	101,2230

For MALT.

1. As 2737,47 is to 28, ſo is 28 to the Area of the Top - - - - - - - - - - - - - - - -	,286
2. As 2737,47 is to 30, ſo is 30 to the Area of the Depth - - - - - - - - - - - - - - -	,328
One Third of the Area of the Depth is	,109
Their Sum is	,723
Half the Depth is	15
	3615
	723
The Content in Buſhels	10,845

By the *Sliding Rule.*

For BEER.

Set 18,94 (the Beer Gauge Point for a Circle) on D, to 1 on C; then againſt the Diameter, *viz.* 28 on D, you'll find the Area thereof on C, *i. e.* 2,1838

And againſt the Depth, *viz.* 30 on D, you'll find 2,5069 on C.

The 3d of the laſt Area found, *viz.* of 2,5066 is 0,8356

Their Sum is 5,5263

Then ſet 1 upon B, to half the Depth on A; and againſt the Sum, *viz.* 5,5256 on B, you'll find 82,8945 the Content required on A, *i. e.* 82 Gallons, 1 Pottle, 1 Quart, 1 Pint, and ,156 of a Pint.

,156

The Operation for Wine and Malt by the Sliding Rule, is in all Reſpects the ſame as above; only inſtead of 18,94 you muſt make Uſe of 17,14, as a Gauge Point for Wine, and of 52,32 as a Gauge Point for Malt.

I have inſerted the preceding Rule for this Purpoſe, being expeditious enough both by the Pen and Inſtrument, nay, more ready and general than any other that I have taken Notice of. But if you'd have one more ſhort, only for the Pen, take the following Rule. To three Times the Square of the Fruſtum's Diameter, add four Times the Square of the Depth, multiply the Sum by the Depth, and divide the Product by 2154 for Beer Gallons, 1764 for Wine, and 1642,82 for Malt Buſhels.

Of Caſk Gauging.

Before we deliver Rules for this Purpoſe, it will not be amiſs to let the Learner know that the Requiſites are,

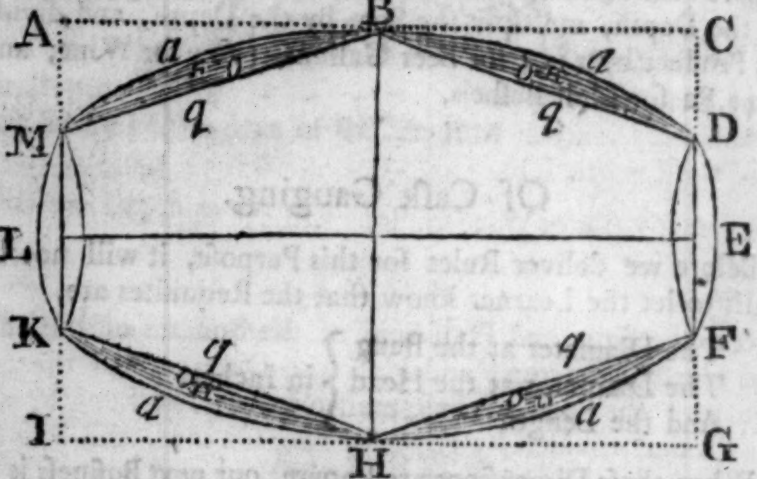
The Diameter at the Bung } in Inches.
The Diameter at the Head } in Inches.
And the Length } in Inches.

When theſe Dimenſions are known, our next Buſineſs is to conſider what the Nature or Form of the Caſk we are to gauge is; for all Authors agree, that there are four Sorts, *viz.*

1. The middle Fruſtum of a Spheroid.
2. The middle Fruſtum of a parabolick Spindle.
3. The middle Fruſtum of two parabolick Conoids, abutting upon one common Baſe; or,
4. The middle Fruſtum of two Cones, abutting upon one common Baſe.

To theſe we may add that of a Cylinder, to which all may be reduced; and though when it has the ſame Length as any of the Figures above-mentioned, and a Diameter the ſame with that of the Bung, the Content will be more than any of them, as may be ſeen by the next Figure following:

Yet when (by the Rules following) we think that we have reduced any given Caſk to a Cylinder, 'tis ſuch a Cylinder, whoſe Length is the ſame with that of the Caſk given: But it's Diameter is ſuch, that it is greater than the Head, and leſs than the Bung's Diameter of the ſame. This will be made more plain, when we ſee the Figures, and conſult the Rules following:



1. In this Figure, ABCGHI may repreſent a Cylinder, whoſe Diameter AI = CG, is equal to the Bung's Diameter BH of the inſcribed Caſks; and conſequently (as by the Figure) muſt contain more than any of them.

2. The middle Fruſtum of a Spheroid may be repreſented by the next inſcribed Caſk, *viz.* M*a*B*a*DEF*a*H*a*KL.

3. The middle Fruſtum of a parabolical Spindle may be repreſented by the next inſcribed Caſk, *viz.* M*n*B*n*DEF*n*H*n*KL.

4. The middle Fruſtum of two Conoids may be repreſented by the Caſks M*o*B*o*DEF*o*H*o*KL.

5. The middle Fruſtum of two Cones (being the leaſt of all) may be repreſented by the Caſk M*q*B*q*DEF*q*H*q*KL; now by this Figure 'tis plain, that a ſpheroidal Caſk is the greateſt (except the Cylinder); the middle Fruſtum of a Parabolick, the next leſs; the middle Fruſtum of two Conoids, leſs than that; and that of two Cones, leaſt of all, as before. This will yet appear more fully by their Contents as in the next Page.

PROB.

PROB. I.

There's a Cask ſuppoſed to be the middle Fruſtum of a Spheroid, as Ma Ba DEFa Ha KL, *whoſe*

Bung Diameter BH is - - - - - -	40	Inches.
The Head Diameter MK = DF is -	30	
And the Length LE - - - - - -	54	

How many Ale or Wine Gallons will the Caſk contain?

RULE.

To the Sum and Half-Sum of the Squares of the Bung and Head Diameters, add Half the Difference of the ſaid Squares; the Sum of theſe multiplied by the Length, and the Product divided by 1077 for Beer Gallons, and 882 for Wine, quotes the Content reſpectively.

EXAMPLE.

The Square of BH, the Bung's Diameter (*i. e.* 40) is - - - - - -	1600
The Square of MK = DF, the Head Diameter (*i. e.* 30) is - - - -	900
The Sum of the Squares is	2500
Half the Sum is	1250
Half the Difference of the Square is	350
Sum is	4100
Length is	54
	164
	205

Ale.

1077) 221400,00 (205,57

00600551

60161

0617

00

882)

882) 221400,00 (251,02 Wine.
4500806
09183
010

Content in Ale - - - - - - -	205,57
Content in Wine - - - - - - -	251,02

PROB. II.

There's a Cask (of the ſame Diameters and Length with the former) ſuppoſed to be the middle Fruſtum of a parabolick Spindle, (as M*n* B*n* DEF*n* H*n* KL*) how many Gallons of Ale and Wine will this Cask contain?*

RULE.

To the Sum and Half-Sum of the Squares of the Bung and Head Diameters, add three Tenth Parts of the Difference of the ſaid Squares; multiply the Sum by the Length, and divide the Product by 1077 for Beer Gallons, and 882 for Wine.

EX-

EXAMPLE.

The Square of BH, the Bung's Diameter (*i. e.* 40) is - - - - - -	1600
The Square of MK = DF, the Head Diameter (*i. e.* 30) is - - - - -	900
Their Sum is	2500
Half Sum is	1250
The Difference of the Square, multiplied by 3, is - - - - - -	210
The Sum of theſe is	3960
Length is	54
	1584
	1980

1077) 213840,00 (198,55 Ale.
10611455
092956
2551
00

882) 213840,00 (242,45 Wine.
3746622
21939
347

The Content in Ale Gallons and Parts is - 198,55
And in Wine - - - - - - - - - - - 242,45 *ſere.*

PROB. III.

There's a Cask whoſe Staves between the Bung and Head have but little Curvature, as M*o* B*o* DEF*o* H*o* KL, *(in the laſt Figure) and ſuppoſed to be the middle Fruſtum of two Conoids; what's the Area of this Cask in Ale and Wine Gallons, ſuppoſing it to have the ſame Diameters and Length with thoſe above?* *RULE.*

RULE.

To the Sum and Half-Sum of the Square of the Bung and Head Diameters, add one Tenth of the Difference of the ſaid Squares; then multiply the Sum by the Length, and divide the Product by 1077 for Beer Gallons, and 882 for Wine.

EXAMPLE.

The Square of the Bung's Diameter, *viz.* BH = 40 is - - - - - -	1600
The Square of the Head Diameter, *viz.* AK = DF is - - - - - -	900
The Sum of the Squares is	2500
Half the Sum of the Squares is	1250
One Tenth of the Difference of the Square, is - - - - - - - -	70
The Sum is	3820
The Length is	54
	1528
	1910

1077) 206280,00 (191,53 Ale.
09855359
016741
0532
00

882) 206280,00 (233,87 Wine.
2982446
34786
766

The Content in Ale Gallons and Parts is -	191,53
And in Wine - - - - - - - - - - -	233,87

PROB.

PROB. IV.

There's a Cask in the Form of the middle Fruſtum of two Cones, abutting upon one common Baſe, as* MqBqDEFqHqKL, *having the ſame Diameters and Length as thoſe above; what's the Content in Beer and Wine Gallons?

RULE.

From the Sum and Half-Sum of the Squares of the Bung and Head Diameters, ſubtract Half the Square of the Difference of the Diameters themſelves; then multiply the Remainder by the Length, and divide the Product by 1077 for Beer Gallons, and 882 for Wine.

EXAMPLE.

The Square of the Bung's Diameter is	1600
The Square of the Head Diameter is	900
Their Sum is	2500
Half the Sum is	1250
The Sum of theſe is	3750
Difference of the Diameter is 10, which ſquar'd is 100, Half of which is	50
The Remainder is	3700
The Length	54
	148
	185

Ale.

1077) 199800,00 (185,51
09214553
059567
0515
00

882)

```
882) 199800,00 (226,53 Wine.
     2346804
      57675
       420
```

The Content in Ale Gallons and Parts is - 185,51
And in Wine - - - - - - - - - - - - 226,35

By the four preceding Problems it appears, that if the Dimenſions are as in the firſt, *viz.* The

Bung's Diameter - - - - - - - -	40	Inches.
Head Diameter - - - - - - - - -	30	
And Length - - - - - - - - - -	54	

That the Content in each Variety will

By *Prob.*	1.	205,57	Ale Gallons and	251,02	Wine Gallons.
	2.	198,55		242,44	
	3.	191,53		233,87	
	4.	185,51		226,53	

Where we may obſerve, that the Difference betwixt the firſt and ſecond, is the ſame as between the ſecond and third; and that of the third and fourth, but a little different from the other: By which it appears, that there's not ſo much Room left for an Error, as was by ſome Rules formerly preſcribed.

It can't be denied, but that a Caſk having the ſame Diameters and Length as that above, may contain ſome certain Quantity between the Contents here found: However, in ſuch Caſes you may proceed by the preceding Rules, adding 1, 2, 3, 4, or 5 tenth Parts of the Difference of the Squares, (as Mr *Everard* directs) according as your Judgment, and the Shape of the Caſk, ſhall direct.

This Caution muſt alſo be obſerved in finding a mean Diameter, when you would reduce a Caſk to a Cylinder, in order to gauge it with the Sliding Rule.

To

To Gauge the middle Fruſtum of a Spheroid another (and more expeditious) Way than is directed in the firſt preceding Problem.

RULE I.

To twice the Square of the Bung's Diameter, add once the Square of the Head; multiply the Sum by the Length, and divide the Product by 1077 for Beer Gallons, and 882 for Wine.

EXAMPLE.

Let the Bung's Diameter be 34 Inches, the Head 24, and Length 48; what's the Content in Beer and Wine Gallons?

For BEER.

Bung's Diameter is - -	34	Head Diameter -	24
	34		24
	136		96
	102		48
Twice it's Square - -	1156 1156	It's Square - -	576
Square of the Head -	576		
Their Sum is - - -	2888		
The Length is - -	48		
	23104		
	11552		

1077) 138624,00 (128,71 Ale Gallons.
030988 13
093643
0713
00
Q

882)

882) 138624,00 (157,17 Wine Gallons.
5042086
63510
160

Area in Beer - - - - - - - - -	128,71	Gallons.
Area in Wine - - - - - - - - -	157,17	

To Gauge a Caſk taken as the middle Fruſtum of a parabolick Spindle another Way.

RULE.

To twice the Square of the Bung's Diameter, add once the Square of the Head; from the Sum take $\frac{2}{5}$ of the Square of the Difference between the Bung and Head Diameters; multiply the Remainder by the Length, and divide the Product by 1077 for Beer Gallons, and by 882 for Wine.

EXAMPLE.

Let the Dimenſions be the ſame as in the laſt Example of a ſpheroidal Caſk; what's the Content in Beer and Wine Gallons?

Twice the Square of the Bung's Diameter is	2312
Once the Square of the Head is	576
Their Sum is	2888
The Difference betwixt the Head and Bung Diameter is 10, it's Square is 100; two Fifths of which is - - - - - - - - - - - - -	40
Remainder is	2848
Length is	48
	22784
	11392
The Dividend is - - - - - -	136704
	1077)

1077) 136704,00 (126,93 Beer Gallons.
02906279
074023
1030
00

882) 136704,00 (154,99 Wine Gallons.
4850622
44728
882

When in Practice you would reduce any of the before-mentioned Caſks to a Cylinder, you may do it near enough the Truth by the Direction following.

RULES.

Take the Difference of the Bung and Head Diameters of any Caſk, and multiply that Difference by the Number which ſtands againſt the Name of the Caſk given in the following Table: Add the Product to the Head Diameter, ſo will the Sum be the Diameter of a Cylinder; (which being of the ſame Length with the given Caſk, will contain as much) ſquare the Diameter thus found, and multiply that Square by the Length, and multiply that laſt Product by ,0028 for Beer Gallons, and ,0034 for Wine.

The Multipliers for a Caſk, which is taken for *Varieties.*

The middle Fruſtum of	1	a Spheroid	is	,7
	2	a parabolick Spindle		,63
	3	two Conoids		,56
	4	two Cones		,51

EXAMPLE.

Let a Caſk be taken as the middle Fruſtum of a Spheroid, the Bung's Diameter let be 20 Inches, the Head 15, and

Length 24; what's the Content in Beer and Wine Gallons according to this Rule?

Bung's Diameter is	20 Inches.
Head Diameter is	15
Difference of Diameters	5
The Caſk's ſpheroidal, therefore the Mult. is	,7
The Product is	3,5
The Sum of the Prod. and Head Diameter is	18,5
	18,5
	925
	1480
	185
The Square of the Sum is	342,25
The Length is	24
	136900
	68450
Product is	821400
Multiplier for Beer	,0028
	65712
	16428
The Content in Beer Gallons	22,9992
The Multiplicand	8214
The Multiplier for Wine	,0034
	32856
	24642
The Content in Wine	27,9276 Gallons.

More Examples of this Kind would be ſuperfluous; for what is ſaid of a Caſk taken as a middle Fruſtum of a Spheroid, may be underſtood of the other three, only inſtead of multiplying the Difference of Diameters by ,7, as above, you muſt uſe ,63, ,56, or ,51, according to the Denomination of the Caſk you are to gauge.

To Gauge Caſks by the *Sliding Rule.*

Upon the Side of the Sliding Rule is placed a Line of Inches, and under it the three firſt Varieties of Caſks, *viz.* The middle Fruſtum of a Spheroid, the middle Fruſtum of a parabolick Spindle, and the middle Fruſtum of two Conoids, and on ſome Rules the middle Fruſtum of two Cones is inſerted upon the oppoſite Side to the others, and has there a Line of Inches fitted to it alſo: The Uſe of theſe Lines is to reduce a Caſk in any of the before-mentioned Forms to a Cylinder, for which Purpoſe you may obſerve the Directions following.

Let a Caſk be given to be gauged in the Form of the middle Fruſtum of a Spheroid, having the ſame Dimenſions as above, *viz.*

	Inches.	
The Bung - - - - - - -	20	what's the Content?
The Length - - - - - - -	24	
And Head Diameter - - -	15	

Firſt, ſubtract the Head Diameter from that of the Bung, and (in this Caſe) you'll find the Difference to be 5 Inches. Find this Difference in the Line of Inches, and againſt that (in the Line for the firſt Variety) you'll find 3, and almoſt 5, which you may call 3,5; add this 3,5 to the Head Diameter, *viz.* 15, and the Sum, *viz.* 18,5 will be the Diameter of an equal Cylinder.

Then ſet 18,94 (the Gauge Point for Cylinders) on D, to the Caſk's Length, *viz.* 24 upon C; then againſt the mean

Diameters, *viz.* 18,5 on D, you'll find 22,99 on C, and that is the Content of the Caſk in Beer Gallons required.

By this Example you may proceed to find the Content of a Caſk in any other Denomination or Variety.

To find ſecond Gauge Points, when the firſt will not perform the Queſtion at one Operation.

Here we muſt remember, that the Diviſors for a Parallelopipedon was 282 for Beer Gallons, 231 for Wine, and 2150 for Malt Buſhels; and for a Cylinder, 359 for Beer Gallons, 294 for Wine, and 2737,47 for Malt, and that the Square Roots of theſe ſeveral Diviſors are as below; which may be inſerted upon the Line D, to uſe as Occaſion requires, and are commonly called Gauge Points.

Diviſors for Squares, *&c.*
282 for Beer Gallons.
231 for Wine Gallons.
2150 for Malt Buſhels.

Gauge Points or Square Roots
16,79 Beer.
15,19 Wine.
46,36 Malt.

Diviſors for Circles, *&c.*
359 for Beer Gallons.
264 for Wine Gallons.
2737,47 for Malt Buſhels.

Gauge Points or Square Roots
18,94 Beer.
17,14 Wine.
52,32 Malt.

The Uſe of theſe Points, and others alſo, (which here I omit) are ſufficiently taught in the preceding Work: Where you may obſerve, when any of them is uſed in gauging Solids, that you are always to ſet that Gauge Point, which according to the Nature of the Figure you are to uſe, on the

Line D, to the Length or Depth of the Solid, on the Line C; and then againſt the Diameter or Side thereof on D, you have it's Content on C. But in ſome Caſes, the Content by theſe Gauge Points can't be found at one Operation: As for Example, ſuppoſe the Diameters of a Cylinder to be 80 Inches, and Depth 76, and the Content in Beer Gallons be required; in this Caſe, when I ſet 18,94 on D, to 76 the Depth on C, I find 80 the Diameter will fall upon no Part of the Line C; which ſhews, that a Cylinder having theſe Dimenſions, can't conveniently be gauged by this Gauge Point at one Set of the Rule, without taking Half the Length, &c. And though this may ſerve your Turn well enough, yet it is neither ſo expeditious nor artificial as when done at one Set of the Rule, without any ſuch halving and doubling as hitherto has been uſed among moſt Officers and others.

CASE I.

When the Lines C and D are ſet even at both Ends, if you find any Gauge Point on D, ſtand on any Part of the firſt *Radius* of the Line C; the ſecond Gauge Point (to that) on D, will fall againſt ſome Part of the ſecond *Radius* of the Line C; but to know on what Part of the Line D, the ſecond Gauge Point will fall, take the following

RULE.

Multiply the Square of any ſuch Gauge Point by 40, and divide the Product by 4; then is the Square Root of the Quotient the ſecond Gauge Point required.

EXAMPLE.

Suppoſe I would find a ſecond Gauge Point to 18,94, in order to ſolve the preceding (or any ſuch) Queſtion;

where the firſt proves deficient, the Square of this firſt
Gauge Point is 359,05
Which multiply by 40
and divide the Product by 4,) 14362,00 (3590,50
230200

The Quotient is 3590,5, whoſe Square Root is 59,92, at which you may make a Point or Prick on the Line D, for a ſecond Gauge Point to 18,94; or in this Caſe, inſtead of multiplying the Square of the Gauge Point by 40, and dividing by 4, you may only move the decimal Point in the Square, one Place farther towards the Right-Hand; ſo will 359,05 become 3590,5, as before. Now to anſwer the former Problem by the ſecond Gauge Point, you may proceed as before, *i. e.* ſet 59,92 on the Line D, to the Depth of the Cylinder, *viz.* 76 on C; then againſt 80, the Diameter on D, you'll find the Content required, *viz.* 1354,8764 Beer Gallons on C. By the ſame Rule, you'll find the ſecond Gauge Point to 17,14 for Wine, to be 54,22; at which you may alſo make a Point or Prick on the Line D, to uſe in ſuch Caſes, where the firſt is deficient; and ſo of any other Gauge Point (in the Caſe) whether for a Circle or Square.

CASE II.

When the Lines C and D are ſet even at both Ends, if you find the firſt Gauge Point on the Line D, to ſtand againſt any Part of the ſecond *Radius* of the Line C; the ſecond Gauge Point on D, will fall againſt ſome Part of the firſt *Radius* of the Line C; but to find upon what Place of the Line D, ſuch a Point will fall, you may take the following

RULE.

Multiply the Square of any ſuch (1.) Gauge Point by 4, and divide the Product by 40; (or by 10, and divide by 100) then the Square Root of the Quotient will be the ſecond Gauge Point required.

EX-

EXAMPLE.

Let 52,32 be the circular Gauge Point for Malt Buſhels, and let a Cylinder, whoſe Diameter is 114 Inches, and Depth 20, be given to be gauged, *i e.* the Content in Malt Buſhels is required.

Set 52,32 on D, to 20 the Depth on C; then you'll find that 114, the Diameter on D, will fall on no Part of the Line C; which ſhews, that the Cylinder can't conveniently be gauged at one Set of the Rule by this Gauge Point; therefore another muſt be found, as below.

The Square of the Gauge Point, *viz.* 55,32 is } 2737,3824
Which multiply by - - - - - 4,
And divide by - - 40,) 10949,52960 (273,73824
29495 2960
1213010

The Quotient is 273,73824, whoſe Square Root is 16,545 for the ſecond Gauge Point required.

Now to gauge the Cylinder, ſet 16,545 on D, to 20 the Depth on C; then againſt 114, the Diameter on D, you'll find Malt Buſhels on C, which (by this ſecond Gauge Point) is the Content at one Set. In this Caſe, the Square of the ſecond Gauge Point might have been found, if (inſtead of multiplying by 4, and dividing by 40) you had placed the decimal Point, one Place towards the Left-Hand in the Square of the firſt Gauge Point given, ſo would 2737,47 become 273,747.

If you would find the ſecond Gauge Points by the Inſtrument itſelf, you may ſet any Number upon the firſt or ſecond *Radius* of the Line C, to the firſt Gauge Point on the Line D; then againſt the ſame Number made ten Times leſs, or ten Times more, on the *Radius* of C, will ſtand a Number on D, which is the Gauge Point required, and muſt be valued according to that Side of the firſt Gauge Point it falls on, *i. e.* if on the left Side, leſs; but if on the right Side of the firſt Gauge Point, it will be more, than it: As if it were required (inſtrumentally) to find a ſecond Gauge Point to 18,94, I ſet 4 on the firſt *Radius* of the Line C, to 18,94 on D; then againſt 40 on the ſecond *Radius* of the Line C, I find 59,92 on the Line D, for the Gauge Point required. *Where note*, that if you had ſet 1, 2, 3, 4, or 5, *&c.* of the firſt *Radius* of the Line C, to 18,94 on D; then would 10, 20, 30, 40, or 50, *&c.* on the ſecond *Radius* of the Line C, fall on the ſame Place of the Line D, *viz.* on 59,92, as before.

To find the Ullage of a Caſk.

Let the Figure following repreſent a Caſk lying with it's Axis parallel to the Horizon, partly empty: Let the Bung's Diameter (*viz.* AB) be 38 Inches, and the Content 130 Gallons: Let CB be the wet Inches=25, and AC the dry Inches=13; I demand how many Gallons are in the Caſk, and how many are drawn out.

For the Solution of this, and ſuch like Problems, I have here inſerted the following Table, from the 94th Page of Mr *Ward's Gauger's Practice*; whoſe Uſe and Conſtruction is as in the next Page.

RULE.

Divide either the wet or dry Inches by the Bung's Diameter, and the Quotient ſeek in the Table under V, the verſed Sine; againſt it ſtands a Number, which multiplied by the Content of the Caſk, exhibits the Vacuity, if your Dividend were the dry; or remaining Liquor, if it were the wet Inches.

Note, That the Table of Segments is made only for a Cylinder; but the Line of Segments on the Sliding Rule is made for a Spheroid, ſo more exact for all bulging Caſks.

EX-

EXAMPLE I.

The wet Inches are 25, which divide by

38) 25,00 (,65
220
3

the Quotient is ,65; and becauſe the Remainder, *viz.* 30, is ſo near the Diviſors, *viz.* 38, you may make the Quotient 66; which find under V, and againſt it (under the Word Area) you'll find ,7002; which multiplied by the Caſk's Content (*viz.* 130) produceth 91,0260, the remaining Liquor required.

EXAMPLE II.

The dry Inches are 13, which divide by

38) 13,00 (,34 Quotient.
168
0

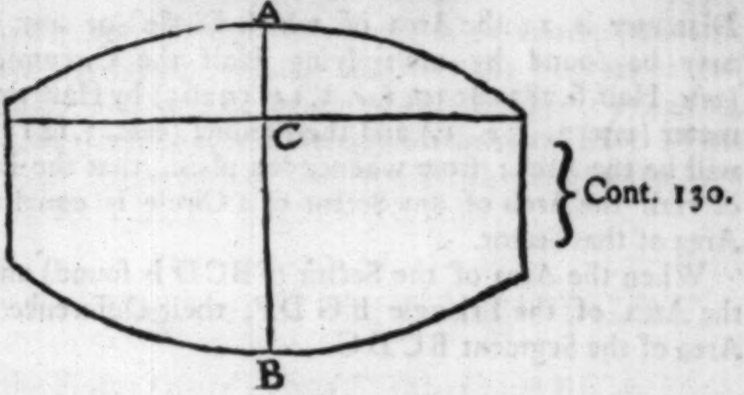
Find this Quotient under V, and againſt it you'll find ,2998; which multiplied by the Caſk's Content, *viz.* 130, produceth 38,9740, the Vacuity required, which added to the remaining Liquor, *viz.* 91,0260, makes 130, the Content; which may prove the Work to be true.

A TABLE

A TABLE of the Segments of a Circle.

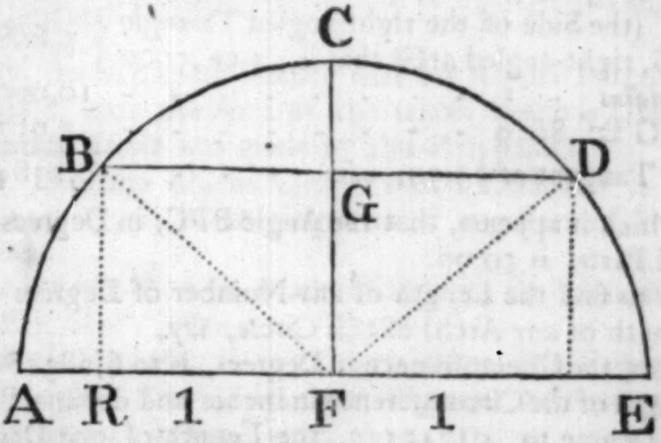
V	Area.	V	Area.	V	Area.	V	Area.
1	,0017	99	,9983	26	,2066	74	,7934
2	,0048	98	,9952	27	,2178	73	,7822
3	,0087	97	,9913	28	,2292	72	,7708
4	,0134	96	,9866	29	,2407	71	,7593
5	,0187	95	,9813	30	,2523	70	,7477
6	,0245	94	,9755	31	,2640	69	,7360
7	,0308	93	,9692	32	,2759	68	,7241
8	,0375	92	,9625	33	,2878	67	,7122
9	,0446	91	,9554	34	,2998	66	,7002
10	,0520	90	,9480	35	,3119	65	,6881
11	,0598	89	,9402	36	,3241	64	,6759
12	,0680	88	,9320	37	,3364	63	,6636
13	,0764	87	,9236	38	,3487	62	,6513
14	,0851	86	,9149	39	,3611	61	,6389
15	,0941	85	,9059	40	,3735	60	,6265
16	,1033	84	,8967	41	,3860	59	,6140
17	,1127	83	,8873	42	,3986	58	,6014
18	,1224	82	,8776	43	,4112	57	,5888
19	,1323	81	,8677	44	,4238	56	,5762
20	,1424	80	,8576	45	,4364	55	,5636
21	,1527	79	,8474	46	,4491	54	,5509
22	,1637	78	,8369	47	,4618	53	,5382
23	,1737	77	,8263	48	,4745	52	,5255
24	,1845	76	,8155	49	,4873	51	,5127
25	,1955	75	,8045	50	,5000	50	,5000

Here the Reader may note, That thoſe Figures in this Table, which differ from thoſe in Mr *Ward*'s Book abovementioned, are placed in the Room of thoſe there which I ſuppoſe were printed falſe; as againſt the verſed Sine 14 (in that Author) is ,0151 for the Area, but ought to be ,0851, as in this Table, &c.



The Conſtruction of the preceding Table.

In the following Figure, that Part of it which is incloſed by the right Line B D, and Arch BCD, is called the Segment of a Circle ; in which GC is called the verſed Sine, and BD it's Chord : Alſo that Part of it which is incloſed by the *Radius* FB, FD, and Arch BCD, is called the Sector of a Circle, and AE the Diameter, which let be 2.



Having the Diameter AE = 2, you may find the Circumference. Thus, As 1 : 3,14159265 :: 2 : 6,28318530, and this 6,28318530 is the Circumference of a Circle, whoſe

Diameter is 2; the Area of which Circle (or any other) may be found by multiplying Half the Circumference (*viz.* Half 6,28318530, *i. e.* 3,14159265) by Half the Diameter (*viz.* 2, *i. e* 1,) and the Product (*viz.* 3,14159265) will be the Area; from whence 'tis plain, that the Length of Half the Arch of any Sector of a Circle is equal to the Area of that Sector.

When the Area of the Sector (FBCD is found) and alſo the Area of the Triangle BGDF, their Difference is the Area of the Segment BCDG.

EXAMPLE.

Let it be required to find the Area of the Segment BCDG, whoſe verſed Sine GC is 5, *i. e.* Half the *Radius* FC = FE = FA = 1.

Firſt, In order to find the Area of the Sector, we muſt find the Quantity of the Angle at the Center, *viz.* BFC = DFC; to find which we have FG = ,5, and BG = ,8659, (*i. e*) a mean Proportional between AF = 1, + FG = 5, (*i e* 1,5). Thus,

As FG (the Side of the right angled Triangle FBG, right-angled at G) that is, ,5 or ,5000	3,698970
Is to *Radius* - - - - - - - - - - - - -	10,000000
So is BG = ,8659 - - - - - - - - - -	3,937468
To the Tangent of 59,99, *viz* - - -	10,2384090

By which it appears, that the Angle BFC, in Degrees and decimal Parts, is 59.99.

Now to find the Length of any Number of Degrees (*i. e.* the Length of any Arch) of this Circle, ſay,

As 360, the Circumference in Degrees, is to 6,28318530, the Length of the Circumference in Inches and decimal Parts: So is 1 Degree to ,01745329, the Length of one Degree. Now the Length of any other Arch may be found thus:

As 1 Degree is to ,01745329, the Length thereof; ſo is any other Number of Degrees to the Length of their reſpective Arches; ſo that ,01745329 is a common Multiplicator for any Number of Degrees: So the Degrees of the Arch BC, *viz.* 59,99. being multiplied by ,01745329, gives 1,0470228671, the Length of the Arch BC; which being Half the Length of the Arch BCD, muſt be the Area of the Sector FBCD, which was required.

To find the Area of the Triangle BGDF.

In the Figure, there's given FG=,5, and BG=,8659, being the Breadth and Length of the Parallelogram RBGF, (which is equal to the two Triangles TGB, and TGD) to find it's Content:

Thus BG is - - - - - - -	,8659
And FG is - - - - - - - - - - - - - - -	,5
The Area of the Parallelogram RBGF, or Triangle BFD, is - - - - - - -	,43295
From the Area of the Sector FBCD -	1,0470228671
Take the Area of the Triangle BFD - -	,43295
And there will remain the Area of the Segment BCDG - - - - - - -	,6140728671

But, becauſe in all Tables that are for this Purpoſe, it is ſuppoſed, that the Area of the whole Circle is Unity, the preceding Table was made by this Proportion.

As the Area of the Circle, whoſe Diameter is 2, *viz.* 3,14159265, is to the Segment of any Part of that Diameter;

So is 1 (the Area of another Circle) to the Segment of the like Part of it's Diameter: That is,

As 3,14159265 is to ,6140728671 (the Segment laſt found); ſo is 1 to ,1954, the Segment anſwering to the verſed Sine 25 in the Table.

For as the verſed Sine of the firſt Segment, *viz.* GC, was 5, *i. e.* ½ the *Radius* FC; ſo is ,25, the verſed Sine of the laſt Segment, ½ of ,50, the *Radius* of the Table:

And what is here ſaid may ſuffice, both for the Uſe and Conſtruction of the Table, which may be uſed when the Caſk is cylindrical; but when the Bung and Head differ much, then the Line of Segments on the Sliding Rule is moſt convenient.

To calculate any Diameter between the Bung and Head of a ſpheroidal Caſk (when the Axis is perpendicular to the Horizon) whoſe Dimenſions

are { A B the Length - - - - - - - - 30 } Inches.
CD the Bung's Diameter - - - - 26
E F the Head's Diameter - - - - 22

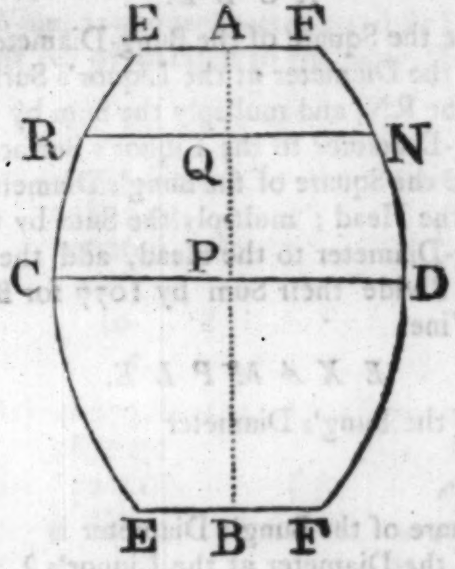
RULE.

From the Square of the Bung's Diameter (CD), ſubtract the Square of the Head Diameter (EF), and divide the Square Root of the Remainder by Half the Caſk's Length (A B); then multiply this Quotient by the Diſtance of the required Diameter from the Bung, which Product you may call your Subducend.

Laſtly, From the Square of the Bung's Diameter, ſubtract the Square of your Subducend, and the Remainder is the Square of the Diameter required.

EXAMPLE.

Let it be required to find the Diameter RN, which we will ſuppoſe to be 10 Inches diſtant from CD, the Bung Diameter.



The Square of the Diameter C D is 676
The Square of the Head Diameter E F is 484

The Difference of the Squares is 192
The Square Root of the Remainder (*viz.* 192) is 13,85

This Root, *viz.* 13,92, divided by Half the Caſk's Length, *viz.* 15, quotes ,92; which multiplied by 10, produceth 9,2 for the Subducend.
Square of the Bung-Diameter 676
Square of the Subducend is 84,64

There remains 591,36

Which is the Square of the Diameter RN, whoſe Square Root is 24,31, the Diameter RN itſelf: Having thus found the Diameter RN, you may find the Content of RNCDEF by the following

RULE.

RULE.

1. To twice the Square of the Bung-Diameter, add once the Square of the Diameter at the Liquor's Surface, (which we ſuppoſe to be RN) and multiply the Sum by the Diſtance from the Bung-Diameter to the Liquor's Surface.

2. To twice the Square of the Bung's Diameter, add once the Square of the Head; multiply the Sum by the Diſtance from the Bung-Diameter to the Head, add theſe two Sums together, and divide their Sum by 1077 for Beer Gallons, and 882 for Wine.

EXAMPLE.

The Square of the Bung's Diameter	676
	676
Twice the Square of the Bung's Diameter is	1352
The Square of the Diameter at the Liquor's Surface, *viz.* RN - - - - - - -	591,36
Their Sum	1943,36
Which multiply by 10, the Diſtance of RN from CD	10
The Product is	19433,60
Twice the Square of the Bung's Diameter is	1352
The Square of the Head is -	484
Their Sum is	1836
Which Sum multiplied by Half the Length, *i. e.*	15
	9180
	1836
Produceth	27540
To which add the Product before ſound, *viz.*	19433,60
Their Sum is	46973,60

Which Sum you may divide by 1077 for Beer Gallons, and 882 for Wine, as above directed; and 8212,41 for Malt (if it be a Caſk cut off parallel to the Bung Diameter).

For BEER.

1077) 46973,60 (43,61 the remaining Liquor in Beer Gallons.
038924(3
0666(6
01(5
(0

For WINE.

882) 46973,60 (53,25 the Content in Wine Gallons and Parts.
28772(0
221(1
5(7

Now having by the fore-going Rules found the Quantity of the remaining Liquor in Beer Gallons to be 43,61, you may take it out of the Caſk's whole Content, *viz.* 51,14 Gallons, and there will remain 7,5; which may inform you, that the Liquor drawn out is 7,53 Gallons, or it will want ſo much to fill it up: Where you may note, that if the Liquor's Surface had been below the Bung, the Difference of the Sums would have been your Dividend.

A more ſpeedy Way to find the remaining Liquor or Vacuity of a Spheroidal Caſk, poſited with it's Axis perpendicular to the Horizon, or ſtanding at one End.

RULE.

Divide the wet or dry Inches by the Caſk's Length, and if the Quotient exceeds ,5000, add to the ſaid Quotient one

Tenth Part of the Exceſs: But if it be under ,5000, ſubtract one Tenth Part of the Want; ſo will the Sum or Remainder be a decimal Number; by which, if you multiply the Content of the Veſſel, the Product will be the Quantity of Liquor therein, if your Dividend was the wet Inches; but the Quantity of Liquor which is required to fill it up, if the Dividend was the dry Inches: But obſerve, that the decimal Places in the Dividend muſt exceed thoſe in the Diviſor (if any be) by 4 Places, and the ſame Caution muſt be obſerved in the next Rule.

EXAMPLE.

Bung Diameter - 28 }
Head - - - - 22 } Ale Gall. Content 60,96 { Wet Inches 18
Length - - - - 32 } { Dry Inches 14

Wet Inches. Quotient.
Length 32) 18,0000 (,5625 this exceeds ,5000 by ,0625,
20860 ,00625 oneTenth of which is ,00625.
010

The Sum is - - ,56875 a Multiplicand, or, &c.
The Content of the Caſk is - } 60,96

341250
511875
3412500

Liquor in the Caſk - - } 34,6710000

To

To find the Vacuity or Quantity of Liquor that the Caſk wants to fill it up.

EXAMPLE I.

Dry Inches.
The Length 32) 14,0000 (,4375 this wants ,0625 of ,5000,
12460 ,00625 is one Tenth of ,0625.
210
This Remainder - - ,43125 the Multiplier, or, &c.
The Caſk's Content is - 60,96
258750
388125
2587500
There want's to fill it up - - - } 26,2890000, to which add the Liquor in the Caſk - 34,6710000, and the Sum will be the Content of the Caſk 60,9600000, when full; which may ſerve as a Proof to both Operations.

EXAMPLE II.

Length - - - - - - - 32 } What Quantity of Liquor
Wet Inches - - - - - - 28 } is in the Caſk, and how
Dry - - - - - - - - - 4 } much will fill it up?

Wet Inches.
Length 32) 280000 (,8750 this exceeds ,5000 by ,3750,
24600 ,0375 is one Tenth of ,3750.
100
Sum is - - - - - ,9125 for a Multiplier, or, &c.
Content - - - - 60,96
54750
82125
547500
The Gallons are 55,626000, which are now in the Caſk.

Dry Inches.

Length 32) 4,0000 (,1250 this wants ,3750 of ,5000,

0860 ,0375 is one Tenth of ,3750.

100

The Diff. Rem is ,0875 for a Multiplier, or, &c.

The Caſk's Content is 60,96

5250

7875

52500

Wants to fill the Caſk - -	5,334000
There is in the Caſk - -	55,626000
Their Sum is the Content	60,960000 for Proof.

To find the Ullage of a Caſk which lies on one Side, or with it's Axis parallel to the Horizon.

RULE.

Divide the wet or dry Inches by the Bung's Diameter ; if the Quotient be above ,5000, add to it one Fourth Part of the Exceſs, and multiply the Sum by the Caſk's whole Content. But if it be under ,5000, take from it one Fourth Part of what it wants, and the Remainder will be a decimal Fraction, which multiplied into the Content, exhibits the Thing required.

EXAMPLE.

Let the Caſk be the ſame as before, only in another Poſition :

Bung Diameter -	28	Ale Gall.	Wet Inches 21
Head - - - -	22	Content 60,96	
Length - - - -	32		Dry Inches 7

What's in the Caſk, and what will fill it up?

Wet Inches.
Bung 28) 21,0000 (,7500 this exceeds ,5000 by ,2500,
14000 ,0625 is one Fourth Part of ,2500.
000

The Sum is - - - ,8125 for a Multiplier, or, *&c.*
The Cont. of the Cask is 60,96

48750
73125
487500

The Liquor in the Cask is - } 49,530000

Note, That if the Quotient proves under ,5000, or above ,8000, instead of one Fourth Part, add or subtract one Fifth Part.

To find the Vacuity, or Quantity of Liquor that the Cask wants to fill it.

Dry Inches.
Bung 28) 7,0000 (,2500 this wants ,2500 of ,5000,
14000 ,0625 is one Fourth Part of ,2500.
000

The Difference is ,1875 for a Multiplicator, or, *&c.*
The Cask's Content is 60,96

11250
16875
112500

There wants to fill the Cask } 11,430000. To which add the contained Liquor 49,530000

The Cask's Cont. 60,960000

If the Caſk you are to ullage be a Cylinder, or near that Form, the preceding Rule will be very near the Truth; but if the Bung Diameter be much greater than the Head Diameter, then inſtead of one Fourth Part (as above) you muſt add or ſubtract but one Third Part, and multiply the Sum or Remainder by the Content; ſo will the Product be what is required.

EXAMPLE.

Let the Content of a Caſk that bulges much, be 60 Gallons.

The Bung Diameter - - - - - - - -	26	Inches.
Wet - - - - - - - - - - - - - -	10	
Dry - - - - - - - - - - - - - -	16	

To find the Vacuity.

Dry Inches.
Bung 26) 16,0000 (,6153 exceeds ,5000 by ,1153
04402 ,0384 is one Third of ,1153
112

Sum - - - - - ,6537
Content - - - - 60

Vacuity - - 39,2220 Gallons.

To Ullage a Caſk by the Sliding Rule, when it's Axis is parallel to the Horizon.

Let a Caſk be in the Form of a middle Fruſtum of a Spheroid.

Whoſe Bung is -	30	Gallons. Content 80,58	Wet Inches 18
Head - - - -	22		
Length - - -	38		Dry Inches 12

What's the Vacuity, and contained Liquor?

To anſwer this Problem, or any other of the like Nature, you have a Line of Segments upon the ſame Side of the Rule with the Lines A and B, which Line is noted at the right End with Seg. *ly.* which may ſignify a Line of Segments for a lying Caſk. To this Line belongs a Line of Numbers marked at the right End with Number.

The Uſe of both are as below.

1. Set the Bung's Diameter, *viz.* 30, upon the Line of Numbers, to 100 on the Line of Segments; then againſt the wet Inches, *viz.* 18, on the Number, you'll find 63,9 on the Line of Segments, which keep.

2. Set 100 upon the Line B, to the Caſk's Content, *viz.* 80,58 on A; then againſt the Number laſt found, *viz.* 63,9 on B, you'll find 51,49 Gallons; and ſo many Gallons are now in the Caſk, becauſe you made Uſe of the wet Inches.

But to know how many it wants of being full,

1. Set the Bung's Diameter, *viz.* 30, on the Line of Numbers, to 100 on the Line of Segments; then againſt the dry Inches, *viz.* 12, on the Line of Numbers, you'll find 36,1 on the Line of Segments, which keep.

2. Set 100 on the Line B, to the Caſk's Content, *viz.* 80,58 on A; then againſt the Number laſt found, *viz.* 36,1 on B, you'll find 29,09 Gallons on the Line A, and ſo much is the Vacuity, becauſe you uſed the dry Inches.

To prove which,

The Vacuity is - - - - - - - - - - - -	29,09
The contained Liquor is - - - - - - - - -	51,49
Their Sum is the Content - - - - - - - -	80,58

And according to theſe two Examples you may proceed to ullage any other lying ſpheroidal Caſk.

To find the Increaſes at ſeveral Inches wet, by the Sliding Rule; uſeful in the Diſtillery.

RULE.

Set the Diameter upon C, to 100 on Seg. *ly*, and ſet down the Segments anſwering to the ſeveral Depths or wet Inches; then ſubtract the firſt Segment from the ſecond, the ſecond from the third, the third from the fourth, *&c.* and call the Remainders the Encreaſe-Segments.

Having found theſe, ſet 100 upon B, to the Caſk's whole Content upon A; then againſt the firſt Segment, and the ſeveral Encreaſe-Segments on B, you'll have the ſeveral Encreaſes on A, which being added together, will (if true) give the Caſk's Content.

EXAMPLE I.

Let the Content of a Caſk be 98,4 Wine Gallons, and Bung's Diameter 30 Inches:

	Inches Wet	Segment	Encreaſe-Seg.	Gallons
And ſuppoſe the	14,	,45		44,3
	19,5	,71	— ,45 = ,26	25,6
	25,3	,92	— ,71 = ,21	20,7
	28,	,98	— ,92 = ,06	5,9
	30, full.	1,00	— ,98 = ,02	1,9

The Sum is the Caſk's Content 98,4

EXAMPLE II.

Let a Caſk of the ſame Dimenſions be given, but ſtanding on one End; the Content being 98,4 Wine Gallons, and Length 38 Inches.

To find the ſeveral Encreaſes in this Poſition, you muſt uſe the Length here as you did the Bung's Diameter before; but uſe the Seg. *ſt.* upon the Sliding Rule.

	Inches Wet	Segment	Encreaſe-Seg.	Gallons
Suppoſe the	14,	,35		34,5
	19,5	,51	— ,35 = ,16	15,7
	25,3	,68	— ,51 = ,17	16,7
	28,	,75	— ,68 = ,07	6,9
	38, full.	1,00	— ,75 = ,25	24,6
	The Sum is the Caſk's Content			98,4

To Ullage a ſpheroidal Caſk, when it's Axis is perpendicular to the Horizon, or ſtanding on one End, by the Sliding Rule.

For this Purpoſe you have a Line of Segments for a ſtanding Caſk on the ſame Side of the Rule with the Lines C and D, (if the Line of Cubes herein before deſcribed is not there) noted with Seg. *St.* againſt which is placed a Line of Numbers, both uſe as below.

Let the Caſk be the ſame as in the laſt, only in another Poſition.

			Gallons.		
Bung	- - - - -	30	Content 80,58	Wet Inches	23
Head	- - - - -	22			
Length	- - - -	38		Dry Inches	15

What's the Vacuity and contained Liquor?

1. For the contained Liquor, ſet the Caſk's Length, *viz.* 38 on the Line of Numbers, to 100 on the Segments; then againſt 23, the wet Inches on the Line of Numbers, you'll find 61,5 on the Line of Segments, which keep.

2. Set 100 on B, to the Caſk's Content, *viz.* 80,58 on A; then againſt the Number laſt found, *viz.* 61,5 on B, you'll find 49,57 on A, and ſo much Liquor is now in the Caſk.

For the Vacuity, or the Liquor wanting to fill the Caſk.

1. Set the Caſk's Length, *viz.* 38 on the Numbers, to 100 on the Segments; then againſt 15, the dry Inches on the Numbers, you'll find 38,2 on the Segments, which keep.

2. Set 100 upon B, to the Caſk's Content, *viz.* 80,58 on A; then againſt 38,2, the Number laſt found on B, you'll find 31,01, the Quantity of Liquor required to fill the Caſk.

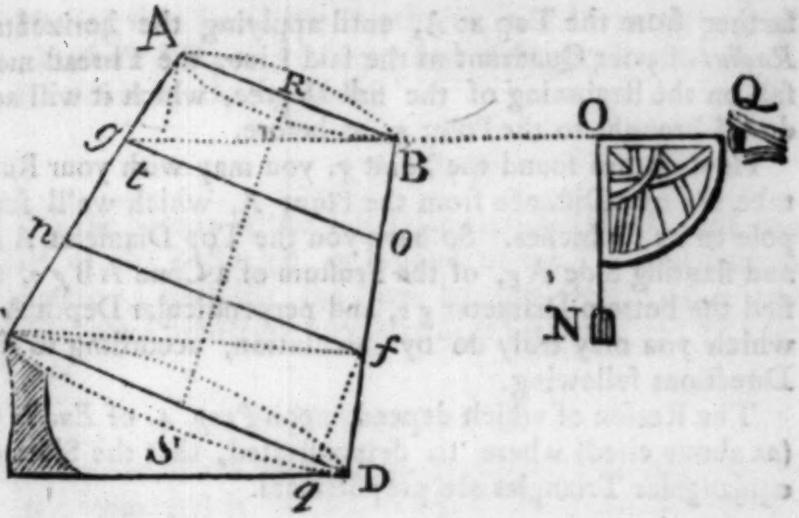
Here (and ſo in the laſt, *i. e.* a lying Caſk) you muſt obſerve, that if you would find the Quantity of Liquor that is in any Veſſel of this Kind, you muſt ſet the Bung or Length to the wet Inches: But if the Vacuity, you muſt ſet them to the dry, according as the Caſk is poſited.

To find the Drip or Fall of a Tun.

Suppoſe a conical Tun (as ABCD) to be ſo poſited, as to have it's Axis RS inclining towards the Horizon, ſo that when the Liquor juſt touches the Angle at C, (made by the Bottom Diameter CD, and Side of the Cone AC) it may wet 20,14 Inches of the oppoſite Side BD, *viz.* D*f*, or when filled ſo as to touch B, may want 18 Inches (on the oppoſite Side) of the Top as A*g*; let the Dimenſions of the Tun be firſt,

The Top Diameter AB - - - - - -	90,	Inches.
Bottom Diameter CD - - - - - -	106,	
Depth RS - - - - - - - - - -	60,	
Slanting Side AC or BD - - - - -	60,53	
According to theſe Dimenſions, the Content of the Tun in Beer Gallons and Parts is - - - - - - - -	1608,69	Gallons.

When



When this Tun is (for Conveniency of cleanſing) ſo poſited as above, and Liquor poured in until it touches the Top Diameter at the Edge B, the Surface of that Liquor may be repreſented by the Line B *g*; by which it appears, that the Part of the Tun A B *g*, will be empty, and ſo the Tun will want ſo much of it's whole Content; but to know how much that is, ſhould be our next Buſineſs.

In order to do this, we ſhould know how many Inches and Parts the Surface of the Liquor at *g* wants of the Top of the Tun at A; which you may eaſily find (if the Tun be filled up to B) by meaſuring from A, to the Liquor at *g*. But if there is no Liquor in the Tun, you may proceed to know where the Point *g* would fall (neverthelesſ) by the Directions following.

Take a Quadrant, and direct the Sights by the Top of the Tun at B, to the oppoſite Side A C, ſtill elevating or depreſſing the ſame, until the Thread *o* N, falls on the Beginning of the firſt Degree on the Limb; which it will do when you ſee the white Speck at *g*, made with Chalk, *&c.* or you may faſten a Line at B, and extend it to the oppoſite Side AC, holding it very tight; then bring it nearer or farther from the Top at A, until applying the horizontal *Radius* of your Quadrant to the ſaid Line, the Thread may fall on the Beginning of the firſt Degree, which it will not do till brought to the Point *g*, as before.

Having thus found the Point *g*, you may with your Rule take it's true Diſtance from the Point A, which we'll ſuppoſe to be 18 Inches. So have you the Top Diameter A B, and ſlanting Side A *g*, of the Fruſtum of a Cone A B *g o*, to find the Bottom Diameter *g o*, and perpendicular Depth A *t*; which you may truly do by Calculation, according to the Directions following.

The Reaſon of which depends upon *Prop.* 4. of *Euclid* 6. (as above cited) where 'tis demonſtrated, that the Sides of equiangular Triangles are proportional.

To find the Diameter *g o*.

RULE.

From the Bottom Diameter C D, *viz.* - - 106 Inches.
Subtract the Top Diameter, *viz.* A B = 90

And there will remain - - - - - - - - - 16
One Half of which is - - - - - - - - - 8

Then ſay, as the ſlanting Side A C = 60,53, is to Half the Difference of the Diameters A B and C D = 8; ſo is the ſlanting Side A *g* = 18, to Half the Difference of the Diameters A B, and *g o* = 2,37, which doubled, and added to the Diameter A B = 90, will be 94,74, the Diameter *g o* required.

To find the Depth A *t*, of the Fruſtum A B *g o*.

RULE I.

Say, as the ſlanting Side A C = 60,53, is to the Depth of the whole Tun R S = 60; ſo is the ſlanting Side A *g* = 8, to it's proper Part of the Depth, *viz.* A *t* = 17,84 required.

Having thus found the Depth A *t*, and Diameter *g o*, of the Fruſtum A B *g o*, you may find what the Part A B *g* A will contain by the following

RULE II.

To the Square of the Top Diameter A B = 90, add one Half of the Rectangle, or Product of the Top and Bottom Diameters; multiply the Sum by the Depth, (A *t*) and divide the Product by 1077 for Beer Gallons, and 882 for Wine.

EXAMPLE.

The Square of the Top Diameter, *viz.* AB is - - - 8100
Half the Product of *g o* = 94,74 into AB = 90 is - - - 4263,30

Their Sum is - - - - - - 12363,30
Which multiply by the Depth A *t* = 17,84

4945320
9890640
8654310
1236330

Gallons.
1077) 220561,272 (204,792
005163348
515948
08922
000

The Content of the whole Tun ABCD in Ale Gallons is - - - - - - - - - - 1208,69
The Content of the Part AB *g* A - - - - - 204,792

The Tun when filled to the Edge B, contains 1003,898

If you'd know how many Gallons is contained in the Part B*go*B, being the lower Part of the Fruſtum AB*go*, you may be ſatisfied by the following

RULE III.

To the Square of the Bottom Diameter, (*go*) add Half the Rectangle or Product of the Bottom Diameter into the Top Diameter (*i. e.* $\frac{1}{2}\,go + AB$); then multiply the Sum by the Depth, and divide the Product by 1077 for Beer Gallons, and 882 for Wine.

EXAMPLE.

The Square of the Bottom or lower Diameter 94 = 94,74 is - - - - - -	8975,6676
Half the Rectangle of the Diameter AB = 90, in 90 = 94,74 is - - - - - - -	4263,30
Their Sum is - - - - - - - - - - - - -	13238,9676
Which you muſt multiply by the Depth A*t* = 17,84, and the Product will be	236183,181984

Divide it by 1077, and the Quotient in Ale Gallons is 219,29729; and ſo much will the Part B*go*B contain, Q. E. F.

To find how much Liquor muſt be poured into the Tun (as it now ſtands) to cover the Bottom CD, take the Rules following.

To do this, you muſt firſt (by the preceding Directions) find A*g*, which is equal to B*o*, and the Diameter *go*; which done, you may proceed to find D*f*: Thus,

Say, as *go* = 94,74, is to CD = 106, ſo is B*o* = A*g* = 18, to D*f* = 20,14; and ſo much of the Side BD will be wet, when the Liquor comes to touch at C.

To

To find the Diameter *fw*.

Firſt, add WC = *f*D = 20,14, to A*g* = B*o* = 18, and their Sum is 38,14; which take from AC = BD = 60,53, and there will remain *gw* = *f*O = 22,39 = *fw*. Add to A*g* = B*o* = 18, and the Sum will be A*w* = B*f* = 40,39. Then ſay,

As AC = BD = 60,53, is to Half the Difference of the Diameters (*viz.* AB = *g o*, and CD = 106), *i. e.* 8, ſo is A*w* = B*f* = 40,39, to Half the Difference of the Diameters AB and *wf*, *i. e.* 5,34; which doubled, and added to AB = *go*, gives 100,68 for the Diameter *fw* required.

To find the Depth *fq*, of the Fruſtum *wf*CD, ſay,

As BD = AC = 60,53, is to the Depth of the Tun, *viz.* RS = 60, ſo is *f*D = 20,14, to *fq* = 19,96. Now to find the Area of the Part DC*f*, you muſt conſult the ſecond Rule before-going, which was given to find the Part B*go*B; Thus,

The Square of the Bottom Diameter, *viz.* DC = 106 is - - - - - - - - - -	11236,
Half the Product of the Diameter CD = 106, in *wf* = 100,68, is - - - - - - -	5336,04
Their Sum is - - - - - - - - - - - -	16572,04
Which multiplied by the Depth *fq* =	19,96
Produceth - - - - - - - - - - - - -	330777,9184
Which Product divide by 1077, and the Quotient will be the Content of DC*f* in Ale Gallons, *viz.* - - - - - - - - - -	307,1289

But if you would find the Content of the other Parts, *viz.* C*fw*, you may conſult the firſt Rule which was given to find the Part AB*g*A, as below.

To

To find the Content of the upper Part of this Fruſtum, *viz.* Cfw.

The Square of the Top Diameter $wf = 100,68$ is - - - - -	- 10136,4624
Half the Product of the Diameter $wt = 100,68$ into $CD = 106$ is -	- 5336,04
Their Sum is - - - - - - - - - - -	15472,5024
Which multiply by the Depth $fq =$	19,96
	928350144
	1392525216
	1392525216
	154725024
And the Product is - - - - - - -	308831,147904
Which divide by 1077, and the Quotient will be the Content of the Part Cfw in Ale Gallons, *i. e.* - - - - - - - - - -	286,7516

Tho' the foregoing Method for finding the Contents of the Hoofs CfD, and Cwf, are pretty near the Truth; yet, that we may have them exactly ſo, take the Rules following.

To find the Content of the greater Hoof CfD.

RULE.

1. Multiply the Square Root of the Rectangle of the Diameters (wf and CD), by the leſſer Diameter; and ſubtract the Product from the Square of the greater Diameter, reſerving the Remainder.

2. Multiply the greater Diameter by the Heighth (*ſq*), divide the Product by the Difference of the Diameters, and multiply the reſerv'd Remainder by the Quotient.

3. Divide the Product by 3,8197, and the Quotient will be the ſolid Content; in this Caſe, is 86964,9341. Which being divided by 282, gives the Content in Ale Gallons, *viz.* 308,3862.

To find the Content of the leſſer Hoof C*wf*.

RULE.

1. Multiply the Square Root of the Rectangle of the Diameters by the greater Diameter, and from the Product ſubtract the Square of the leſſer Diameter, and reſerve the Remainder.

2. Divide the Product of the Heighth and leſſer Diameter, by the Difference of the Diameters, and multiply the reſerv'd Remainder by the Quotient; then divide the Product by 3,8197, the Quotient will be the ſolid Content; in this Caſe, 80485,469: Which being divided by 282, gives 285,4094 Ale Gallons.

How the Diviſors, hitherto made uſe of, may be found, by knowing what Proportion their reſpective Figure has to it's circumſcribing Cylinder or Parallelopipedon.

A Cylinder is $\frac{177,5}{226}$ of the Parallelopipedon that circumſcribes it, and 282 and 231 are the Number of Inches contained in an Ale or Wine Gallon, according to the Statute, and the proper Diviſors for a Parallelopipedon; I demand the Diviſors for a Cylinder.

Say, as 177,5 the Numerator, is to 226 the Denominator; ſo is the Diviſor for a Parallelopipedon, to the Ale Diviſor for a Cylinder.

As 177,5 : 226 : : 6282
226
1692
564
564
177,5) 63732,0000 (359,053 Ale Diviſor for a Cylinder.
104875055
1609522
00969
00

For the Wine Diviſor, ſay,

As 177,5 : 226 : : 231 the Wine Diviſor for a Parallelopipedon.
226
1386
462
462
177,5) 52206,0000 (294,118 the Wine Diviſor for a Cylinder.
167010550
0731275
02345
010

For a Malt Diviſor.

2150,419 being the Diviſor for a Parallelopipedon.

As 177,5 : 226 : : 2150,419 : 2737,99, *&c.* the Diviſor for a Circle Cylinder, *&c.* But in the practick Part of this Art, it is agreed, that 2737,47 muſt be uſed, as is before-noted.

A Cone that is circumſcribed by a Cylinder of the ſame Diameter and Heighth, is one Third thereof, *Vid. Hayes's Mathem. Philoſ.* Pag. 161.

PROB. II.

A Cone being $\frac{1}{3}$ of a Cylinder, I demand the Beer, Wine, and Malt Diviſors for a Cone; thoſe of the Cylinder being for Beer 359,053, *for Wine* 294,118, *and* 2737,47.

For the Wine Diviſor.

As 1 : 3 :: 294,118
3
882,354 Wine Diviſor for a Cone.

For the Beer Diviſor.

As 1 : 3 :: 359,053 :
3
1077,159 The Beer Diviſor for a Cone.

For the Malt Diviſor.

As 1 : 3 :: 2737,99 : 8213,07 But you may uſe
3 8212,41 (if an Officer.)
8213,97

I ſhall inſiſt no farther in theſe Examples, becauſe what is ſaid of the Cone is ſufficient to inform the meaneſt Capacity how to proceed in the Globe, Spheroid, Square, Pyramid, parabolick Conoid, hyperbolick Conoid, and parabolick Spindle, when he knows what Part of their circumſcribing Cylinder they are; and when that is known, the Proportion will be as the Numerator is to the Denominator, ſo is the Beer, Wine, and Malt Diviſors of a Cylinder, to the like Diviſors for that Figure.

A Cylinder is $\frac{11}{14}$ of the Parallelopipedon that circumſcribes it, or (nearer) $\frac{177,5}{226}$ of it, as above.

A Cone is $\frac{1}{3}$ of it's circumſcribing Cylinder.

A Globe is $\frac{2}{3}$ of the Cylinder that circumſcribes it, having equal Diameters and Heighth.

A Spheroid is $\frac{2}{3}$ of the Cylinder, whoſe conjugate is the Diameter, and tranſverſe Diameter the Depth of the Cylinder

As a Cone is $\frac{1}{3}$ of a Cylinder, ſo a ſquare Pyramid is $\frac{1}{3}$ of that Parallelopipedon that circumſcribes it, having the ſame Baſe and Altitude; and in general, let the Baſe of a Pyramid be what you pleaſe, *i. e.* ſquare, circular, triangular, polygonal, *&c* they will be but $\frac{1}{3}$ of their circumſcribing Priſms, that have the ſame Baſe and Heighth.

A parabolick Conoid is $\frac{1}{2}$ of the Cylinder that circumſcribes it, ſuppoſing it to have the ſame Baſe and Altitude with that of the Cylinder

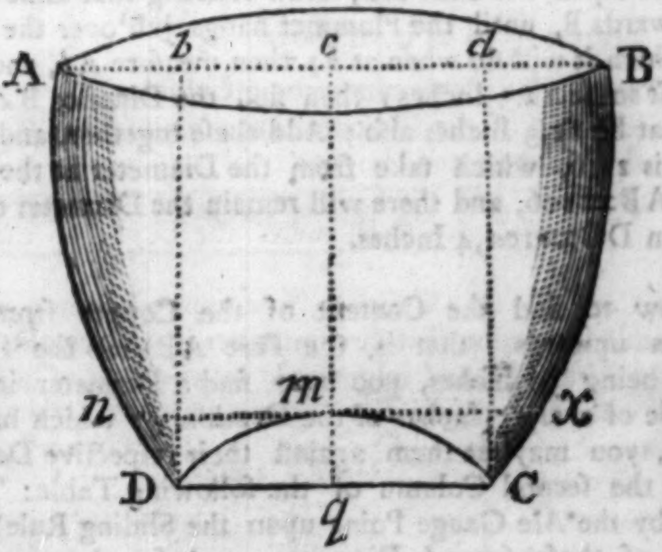
A hyperbolick Conoid is $\frac{5}{12}$ of that Cylinder that circumſcribes it, having the ſame Baſe and Altitude as the Cylinder.

A parabolick Spindle is $\frac{8}{15}$ of that Cylinder, whoſe Axis is the ſame with the parabolick Spindle, and Diameters equal.

He that would know more of the Nature of theſe Figures, may have Recourſe to that ingenious Piece of Work done by Mr *Hayes*, intituled, ***Mathematical Philoſophy***, where from Page 161 to Page 177, they may be fully ſatisfied.

To Gauge a Copper, and make Allowance for the Crown.

Let ABCD repreſent a Copper to be gauged, the Dimenſions may be taken, and the Content found, as below.



1. **Firſt, faſten a ſmall Chord or Thread at A, and extend the other End diametrically to the Point B, where faſten it alſo; then ſet one End of your Inſtrument on D, and move the upper End thereof toward A or *c*, till you find the neareſt Diſtance of the Point D, to the Thread A B, which will be when moved to *b*; let *b*D be 40 Inches, the Depth of the Furnace or Copper.**

2. **In like manner, ſet one End of your Inſtrument upon the Top of the Crown at *m*, and take the neareſt Diſtance of**

of that Point to the Line A B, which let be *c m* = 30 Inches; which take from D *b* = C *d* = 40, and there will remain the Depth or Heighth *m q* = 10 Inches.

To find the Diameter of the Crown D C, meaſure A B, and call it 126 Inches.

Then take a Thread and Plummet, and ſetting one End thereof upon the Line A B, draw it along that Line from A towards B, until the Plummet hangs juſt over the Point D, which it will do when at *b*; then meaſure A *b*, and ſuppoſe it to be 12,3 Inches; then find the Diſtance B *d*, and let that be 12,3 Inches alſo: Add theſe together, and their Sum is 24,6, which take from the Diameter at the Top, *viz.* A B = 126, and there will remain the Diameter of the Crown D C = 101,4 Inches.

Now to find the Content of the Copper from the Crown upwards, (that is, the Part A B *n x*) the Depth (*m c*) being 30 Inches, you may find a Diameter in the Middle of every 5 Inches of the Depth *m c*; which having found, you may ſet them againſt their reſpective Depths, as in the ſecond Column of the following Table: Then find (by the Ale Gauge Point upon the Sliding Rule) the Areas of thoſe ſeveral Diameters, and ſet them againſt their proper Diameters in the third Column: Having ſo done, the fourth Column is made by multiplying each Area by 5, ſo have you the Content of the Part A B *n x*, at every 5 Inches of the Depth *m c*, which added together makes

Bar. Fir. Gall.
32 : 00 : 3,3.

Parts,

Parts of the Depth	Diameters	The Areas of thoſe Diameters	Content of every 5 Inches reduced to		
			Bar.	Fir.	Gall.
5	124,8	43,38	6 :	01 :	4,4
5	119,9	40,04	5 :	03 :	4,7
5	115,7	37,3	5 :	01 :	8,0
5	111,3	34,5	5 :	00 :	2,5
5	108,8	32,97	4 :	03 :	3,4
5	103,9	30,06	4 :	01 :	5,8
30	Sum is	- -	32 :	00 :	3,3
To cover the Crown			4 :	03 :	5,8
Content of the Copper			36 :	03 :	9,1

For the Content of the Part nx D C.

The Diameter nx is 110,6, and $DC=101,4$, and the Depth mq is 10.

The Area of the Top Diameter, *viz.* $nx=110,6$ is - - - - - - - } 34,0734

The Area of the Bottom Diameter, *viz.* $DC=101,4$ - - - - - - - - } 28,64

A Geometrical Mean by the Sliding Rule is 31,24
Which multiplied by the Depth $mq=$ 10,

The Product will be the Content required, *viz.* - - - - - - } - 312,40 Gallons.

For the Content of the Part D m C q D.

If we ſuppoſe this Part to be the Fruſtum of a Globe; it's Diameter D C being 101,4 Inches, and Altitude $mq=10$.

The Content (by the Rule herein before given for this Purpoſe) will be found to be 145,0565 Gallons.

Now if we ſubtract the Content of the Crown (D *m* C *q* D) laſt ſound, *viz.* 145,0565 from the Content of the Parts *n x* DC, *viz.* 312,4, there will ~~remain~~ 167,3435 Gallons, and ſo much Liquor the Crown will take to cover it;
Bar. Fir. Gall.
which is 4 : 03 : 5,8. Add this to the Part AB *n x*, *viz.*
Bar. Fir. Gall.
32 : 00 : 3,3, and the Sum will be the Content of the
Bar. Fir. Gall.
Furnace or Copper A D *m* C B, *viz.* 36 : 03 : 9,1, which was required, and the ſame may be done in any other the like Caſe. And note, that the more curved the Sides of any Figure is, the more mean Circles you ought to take, *i. e.* in the Middle of every 8, 6, or 4 Inches, *&c.*

Having the Diameters and Depth of any conical Tun, to find the Diameter at any Depth at one Operation.

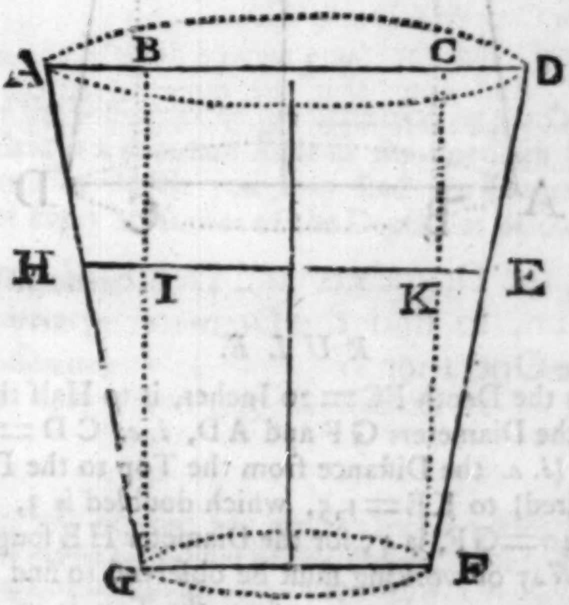
RULE.

Say, as the Depth of the Tun is to Half the Difference of the Bottom and Top Diameters, ſo is any Depth to Half the Difference between the Bottom Diameter, and that at the Depth propoſed; which doubled and added to the Bottom Diameter, the Sum will be the Diameter required.

EXAMPLE I.

Let ABCDEFGH repreſent a Tun in the Form of the Fruſtum of a Cone ſtanding on it's leſſer Baſe; let the Diameter AD be 50 Inches, the Diameter GF 40 Inches, and the Depth BG or CF 20, and the given Depth KF or IG = 14 Inches to find the Diameter HE.

The Triangles CFD and KFE being ſimilar, the Proportion will be as before, *i. e.* as the Depth of the Tun CF = 20, is to DC Half the Difference of AD, and FG = 5; ſo is KF = 14, to KE Half the Difference of GF and HE, *viz.* 3,5, which doubled is 7, and this added to the Bottom Diameter GF, gives 47 for the Diameter HE required; and the like may be done for the Diameter at any other Depth, when the Tun ſtands upon it's leſſer Baſe.

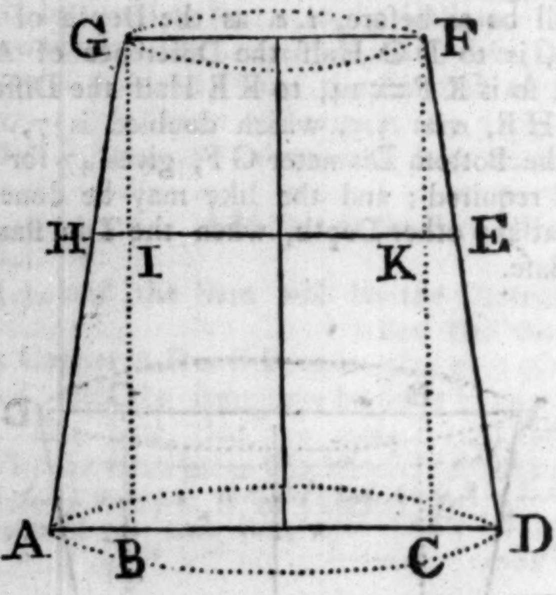


EXAMPLE II.

Let a Tun having the ſame Dimenſions be given, only in another Poſition, *i. e.* ſtanding upon it's greater Baſe; and it be required to find the Diameter at 14 Inches from the Bottom, as above.

I demand the ſaid Diameter.

RULE.



RULE.

Say, as the Depth FC = 20 Inches, is to Half the Difference of the Diameters GF and AD, *i. e.* CD = 5, ſo is FK = 6, (*i. e.* the Diſtance from the Top to the Diameter HE required) to KE = 1,5, which doubled is 3, and this added to 40 = GF, is 43 for the Diameter HE ſought; and the ſame Way of working muſt be obſerved to find the Diameter at any other Depth, when the Tun is in this Poſition. Where note, that in either of theſe Figures we may ſuppoſe the Line HE to be the Diameter of the Liquor's Surface, which, with the Depth 14, and Bottom Diameter, the true Quantity of Liquor may be found which is now in the Tun, or which it will hold at 14 Inches deep.

To

To find how many Gallons a conical Tun will hold upon every Inch of the Depth.

Let the Diameter at the Top be - - - - - 18 }
The Diameter at the Bottom - - - - - - 98 } Inches.
Depth - - - - - - - - - - - - - - 40 }

The Content in Ale Gallons is 885,5, how many Ale Gallons will this Tun hold upon every Inch of it's Depth?

RULE.

Divide the Difference of the Diameters by the Depth, and the Quotient is a common Addend for one Inch from Top to Bottom; by which you may find the Diameter in the Middle of every 10 Inches of the Depth, as below.

Bottom Diameter - - - - - 98
Top Diameter - - - - - - 80
Their Difference - - - - - 18 for a Dividend, which
divide by 40) 18,00 (,45 the Addend for one Inch.
20(0
0

Now 5, 15, 25, and 35, are the Inches which fall in the Middle of every 10 Inches of the Depth, which Depths, if you multiply by the common Addend, will ſhew what muſt be added to the Top Diameter, to find the Diameters at thoſe Depths. Thus,

5,	15,	25,	35,
,45	,45	,45	,45
2,25	6,75	11,25	15,75

80, Top Diameter
2,25

Gall. Bar. F. Gall.
82,25 Diameter at 5 Inches deep, it's Area 18,84 = 00 : 2 : 1,84

80, Top Diameter
6,75

86,75 Diameter at 15 Inches deep, it's Area 20,96 = 00 : 2 : 3,96

80, Top Diameter
11,25

91,25 Diameter at 25 Inches deep, it's Area 23,19 = 00 : 2 : 6,19

80, Top Diameter
15,75

95,75 Diameter at 35 Inches deep, it's Area 25,53 = 00 : 3 : 0,03

The Sum of the Areas are - - 88,52, which multiplied by 10, is 885,2, the Tun's Content.

Bar. Fir. Gall.
Now 18,84 Gallons, or 00 : 02 : 1,84, being an Area common to any of the firſt ten Inches; you are to ſubtract either of them from the Tun's Content in the like Name continually, and the Remainder will be the Area at each of the firſt ten Inches; and then for the next ten Inches you
Bar. Fir. Gall.
muſt take 20,96, or 00 : 02 : 3,96, out of the laſt Remainder, &c. as in the following Table.

The whole Content is 885,2 Gallons, or

Bar.	Fir.	Gall.Pts.
26	00	1,20
	02	1,84
25	01	7,86
	02	1,84
24	03	6,02
	02	1,84
24	01	4,18
	02	1,84
23	03	2,34
	02	1,84
23	01	0,50
	02	1,84
22	02	7,16
	02	1,84
22	00	5,32
	02	1,84
21	02	3,48
	02	1,84
21	00	1,64
	02	1,84
20	01	8,30
	02	3,96
19	03	4,34
	02	3,96
19	01	0,38
	02	3,96
18	02	4,92
	02	3,96
18	00	0,96
	02	3,96
17	01	5,50
	02	3,96
16	03	1,54

Note,

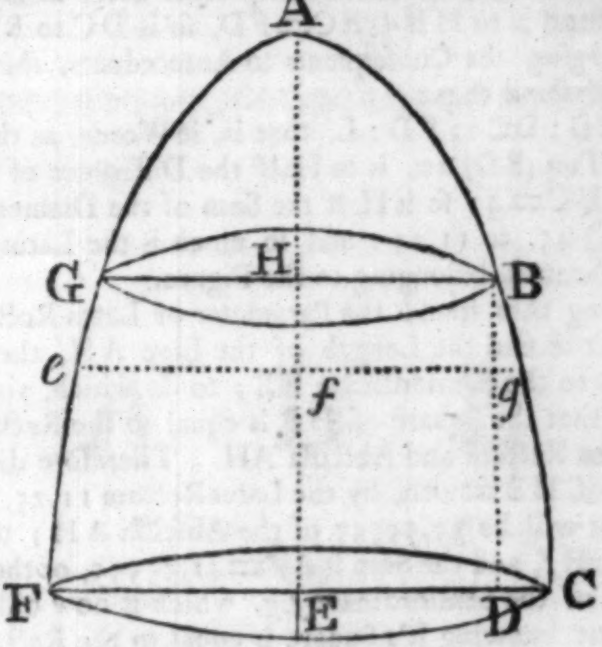
	Bar.	Fir.	Gall.Pts.
	16	03	1,54
		02	3,96
	16	00	6,08
		02	3,96
	15	02	2,12
		02	3,96
	14	03	6,66
		02	3,96
	14	01	2,70
Note,		02	6,19
	13	02	5,01
		02	6,19
	12	03	7,32
		02	6,19
	12	01	1,13
		02	6,19
	11	02	3,44
		02	6,19
	10	03	5,75
		02	6,19
	10	00	8,06
		02	6,19
	9	02	1,87
		02	6,19
	8	03	4,18
		02	6,19
	8	00	6,49
		02	6,19
	7	02	0,30
Note,		03	0,03
	6	03	0,27
		03	0,03
	6	00	0,24

Bar.	Fir.	Gall.Pts.
6	00	0,24
	03	0,03
5	01	0,21
	03	0,03
4	02	0,18
	03	0,03
3	03	0,15
	03	0,03
3	00	0,12
	03	0,03
2	01	0,09
	03	0,03
1	02	0,06
	03	0,03
0	03	0,03
	03	0,03
0	00	0,00

The Table following is collected from the preceding Work, whoſe Uſe is to find how much Liquor is in ſuch a Tun, by having the Diſtance of the Liquor's Surface from the Top: Thus, let it be 20 Inches, look 20 in the firſt Column, and againſt it you'll find 14 : 01 : 2,70 (Bar. Fir. Gall.Pts.), *i. e.* 14 Barrels, 1 Firkin, 2 Gallons, and ſeven Tenth Parts, and ſo for any other Fruſtum of a Pyramid.

Inches	Barrels	Firkins	Gall. Pts.
0	26	00	1,20
1	25	01	7,86
2	24	03	6,02
3	24	01	4,18
4	23	03	2,34
5	23	01	0,50
6	22	02	7,16
7	22	00	5,32
8	21	02	3,48
9	21	00	1,64
10	20	01	8,30
11	19	03	4,34
12	19	01	0,38
13	18	02	4,92
14	18	00	0,96
15	17	01	5,50
16	16	03	1,54
17	16	00	6,08
18	15	02	2,12
19	14	03	6,66
20	14	01	2,70
21	13	02	5,01
22	12	03	7,32
23	12	01	1,13
24	11	02	3,44
25	10	03	5,75
26	10	00	8,06
27	9	02	1,87
28	8	03	4,18
29	8	00	6,49
30	7	02	0,30
31	6	03	0,27
32	6	00	0,24
33	5	01	0,21
34	4	02	0,18
35	3	03	0,15
36	3	00	0,12
37	2	01	0,09
38	1	02	0,06
39	0	03	0,03
40	0	00	0,00

To find the Diameter at any Depth of a Tun, in the Form of the Fruſtum of a parabolick Conoid.



DEFINITIONS.

If we conceive the curve Line FGABC to repreſent a Parabola; then

HB is called a Semiordinate, and AH it's Abſciſſa; and ſo EC is a Semiordinate, and AE it's Abſciſſa.

The Latus Rectum of a Parabola (as of this) is ſuch a Line, as that being multiplied by the Abſciſſa AH, the Rectangle or Product will be equal to the Square of HB.

If you multiply it by the Abſciſſa AE, then the Rectangle will be equal to the Square of EC, and will always be ſo, as in *Apoll. Prop.* 11. *Lib.* 1.

Now to find the Latus Rectum of the Parabola, by having only the Top Diameter GB=40, the Bottom Diameter FC=50, and the Depth HE or BD=20, muſt be performed by that Property of the Parabola, commonly called *Baker's Property*, whereon his *Clavis Geometrica Catholica* depends, and is this:

In the Parabola, the Latus Rectum is to the Sum of any two Semiordinates, as their Difference is to the Difference of their Abſciſſa; that is in this preſent Caſe, as L (the Latus Rectum) is to HB + EC = FD, ſo is DC to BD: And by changing the Conſequents to Antecedents, the Proportion will ſtand thus:

As BD : DC : : FD : L, that is, in Words, as the Depth of the Tun (BD) 20, is to Half the Difference of the Diameters DC = 5; ſo is Half the Sum of the Diameters (GB and FC) 45, to 11,25; and ſo much is the Latus Rectum of the Parabola belonging to the Figure.

Having thus found the Parameter or Latus Rectum, we are next to find the Length of the Line AH, the proper Abſciſſa to the Semiordinate HB; to do which, you are to know, that the Square of HB is equal to the Rectangle of the Latus Rectum and Abſciſſa AH. Therefore divide the Square of HB = 400, by the Latus Rectum 11,25, and the Quotient will be 35,55555 of the Abſciſſa AH; to which add 6 = H*f*, and the Sum is A*f* = 41,55555, or the proper Abſciſſa of the Semiordinate *fg*, which is now only wanting. But knowing it's Square is equal to the Rectangle of the Latus Rectum and Abſciſſa A*f*, multiply 41,55555 by 11,25, and the Product is —— 467,4999375, which is the Square of the Semiordinate *fg*; the Square Root of which is 21,6217, which doubled is 43,2434, the Diameter *eg* required; and ſo of any other. This will not appear difficult to any who underſtand ſo much of the Conick Sections as is requiſite for the Conſtruction of Algebraick Equations.

Many Things of this Nature I might inſiſt upon, as in ſhowing how to find the Diameters at every Inch of the Depth of this, or any other regular Tun: But what has been ſaid already, may be ſufficient to excite the induſtrious Reader to peruſe others who have taken more Room in Writing to that Purpoſe, than I have Time to do at preſent. But if what is here done proves any way ſerviceable, I have my Deſire; and, by knowing it to be approved of, ſhall be encouraged thereby to publiſh ſome things in the Art of Gauging, as may oblige Poſterity.

A

TABLE

OF

Circles, *Areas*, in Malt Buſhels and decimilleſimal Parts, calculated to every Tenth Part of an Inch of the Diameter from 12 to 100 Inches.

Areas of Circles

D.	0	1	2	3	4
12	0.0526	0.0534	0.0543	0.0552	0.0561
13	0.0617	0.0626	0.0636	0.0646	0.0656
14	0.0716	0.0726	0.0736	0.0747	0.0757
15	0.0822	0.0833	0.0844	0.0855	0.0866
16	0.0935	0.0946	0.0957	0.0970	0.0982
17	0.1055	0.1068	0.1080	0.1093	0.1106
18	0.1183	0.1196	0.1210	0.1223	0.1236
19	0.1318	0.1332	0.1346	0.1360	0.1374
20	0.1461	0.1475	0.1490	0.1505	0.1520
21	0.1611	0.1626	0.1642	0.1657	0.1670
22	0.1768	0.1784	0.1800	0.1816	0.1833
23	0.1932	0.1949	0.1966	0.1983	0.2000
24	0.2104	0.2121	0.2139	0.2157	0.2174
25	0.2283	0.2301	0.2319	0.2338	0.2356
26	0.2469	0.2488	0.2507	0.2526	0.2546
27	0.2663	0.2682	0.2702	0.2725	0.2758
28	0.2864	0.2884	0.2904	0.2925	0.2946
29	0.3072	0.3093	0.3114	0.3136	0.3151
30	0.3287	0.3309	0.3331	0.3353	0.3376
31	0.3512	0.3516	0.3556	0.3578	0.3601
32	0.3740	0.3764	0.3787	0.3810	0.3834
33	0.3978	0.4002	0.4026	0.4050	0.4075
34	0.4222	0.4247	0.4272	0.4297	0.4322
35	0.4475	0.4500	0.4526	0.4552	0.4577
36	0.4735	0.4760	0.4787	0.4813	0.4840
37	0.5001	0.5028	0.5055	0.5082	0.5109
38	0.5275	0.5302	0.5330	0.5358	0.5386
39	0.5556	0.5684	0.5613	0.5642	0.5670
40	0.5844	0.5874	0.5903	0.5932	0.5962
41	0.6140	0.6170	0.6200	0.6230	0.6261
42	0.6444	0.6474	0.6505	0.6536	0.6567
43	0.6754	0.6786	0.6817	0.6849	0.6880

in Malt Buſhels.

5	6	7	8	9
0.0570	0.0579	0.0589	0.0598	0.0607
0.0657	0.0675	0.0685	0.0695	0.0705
0.0768	0.0778	0.0792	0.0800	0.0811
0.0877	0.0888	0.0900	0.0912	0.0923
0.0994	0.1006	0.1018	0.1031	0.1042
0.1118	0.1131	0.1144	0.1157	0.1170
0.1250	0.1263	0.1277	0.1291	0.1304
0.1389	0.1403	0.1417	0.1432	0.1446
0.1535	0.1550	0.1565	0.1580	0.1595
0.1688	0.1704	0.1720	0.1736	0.1752
0.1850	0.1866	0.1882	0.1899	0.1915
0.2017	0.2034	0.2052	0.2070	0.2086
0.2192	0.2210	0.2228	0.2246	0.2264
0.2375	0.2394	0.2412	0.2431	0.2450
0.2565	0.2584	0.2604	0.2623	0.2643
0.2762	0.2782	0.2803	0.2823	0.2843
0.2968	0.2988	0.3009	0.3029	0.3151
0.3178	0.3200	0.3215	0.3244	0.3265
0.3398	0.3420	0.3443	0.3465	0.3488
0.3624	0.3647	0.3670	0.3694	0.3717
0.3858	0.3882	0.3906	0.3930	0.3954
0.4099	0.4124	0.4148	0.4173	0.4198
0.4348	0.4373	0.4398	0.4424	0.4449
0.4603	0.4629	0.4655	0.4681	0.4708
0.4866	0.4893	0.4920	0.4947	0.4974
0.5137	0.5164	0.5192	0.5219	0.5247
0.5414	0.5442	0.5471	0.5499	0.5527
0.5699	0.5728	0.5757	0.5786	0.5815
0.5991	0.6021	0.6050	0.6081	0.6110
0.6291	0.6321	0.6352	0.6382	0.6444
0.6598	0.6629	0.6660	0.6691	0.6723
0.6912	0.6944	0.6976	0.6978	0.7040

Areas of Circles

D.	0	1	2	3	4
44	0.7072	0.7104	0.7136	0.7169	0.7201
45	0.7397	0.7430	0.7463	0.7496	0.7529
46	0.7729	0.7763	0.7797	0.7831	0.7864
47	0.8069	0.8104	0.8138	0.8173	0.8207
48	0.8416	0.8451	0.8486	0.8522	0.8557
49	0.8770	0.8826	0.8842	0.8878	0.8914
50	0.9132	0.9169	0.9206	0.9242	0.9279
51	0.9501	0.9538	0.9576	0.9613	0.9650
52	0.9877	0.9915	0.9954	0.9992	1.0030
53	1.0261	1.0300	1.0338	1.0377	1.0416
54	1.0652	1.0691	1.0731	1.0770	1.0810
55	1.1050	1.1090	1.1130	1.1171	1.1211
56	1.1455	1.1496	1.1537	1.1579	1.1620
57	1.1868	1.1910	1.1952	1.1993	1.2035
58	1.2288	1.2331	1.2373	1.2416	1.2458
59	1.2716	1.2759	1.2802	1.2845	1.2889
60	1.3150	1.3194	1.3238	1.3282	1.3326
61	1.3593	1.3637	1.3680	1.3726	1.3771
62	1.4042	1.4087	1.4133	1.4178	1.4224
63	1.4498	1.4544	1.4591	1.4637	1.4683
64	1.4962	1.5009	1.5056	1.5103	1.5150
65	1.5434	1.5581	1.5529	1.5576	1.5624
66	1.5912	1.5960	1.6009	1.6057	1.6100
67	1.6398	1.6447	1.6496	1.6545	1.6504
68	1.6891	1.6941	1.6991	1.7040	1.7090
69	1.7392	1.7442	1.7493	1.7543	1.7594
70	1.7899	1.7951	1.8002	1.8053	1.8104
71	1.8414	1.8466	1.8518	1.8570	1.8622
72	1.8937	1.8989	1.9043	1.9095	1.9148
73	1.9466	1.9522	1.9573	1.9627	1.9680
74	2.0003	2.0058	2.0112	2.0166	2.0220
75	2.0548	2.0603	2.0658	2.0712	2.0768

in Malt Buſhels.

5	6	7	8	9
0.7233	0.7266	0.7299	0.7331	0.7364
0.7572	0.7596	0.7629	0.7662	0.7696
0.7898	0.7932	0.7966	0.8001	0.8035
0.8242	0.8277	0.8311	0.8346	0.8381
0.8592	0.8628	0.8664	0.8699	0.8735
0.8950	0.8987	0.9023	0.9059	0.9096
0.9316	0.9353	0.9390	0.9427	0.9464
0.9688	0.9726	0.9764	0.9802	0.9839
1.0008	1.0110	1.0145	1.0184	1.0222
1.0455	1.0495	1.0534	1.0573	1.0612
1.0850	1.0890	1.0935	1.0970	1.1010
1.1252	1.1292	1.1333	1.1374	1.1415
1.1611	1.1702	1.1744	1.1785	1.1827
1.2077	1.2119	1.2162	1.2204	1.2246
1.2501	1.2544	1.2587	1.2630	1.2673
1.2934	1.2976	1.3019	1.3063	1.3107
1.3371	1.3415	1.3459	1.3503	1.3548
1.3816	1.3868	1.3906	1.3951	1.3997
1.4269	1.4315	1.4361	1.4406	1.4452
1.4729	1.4776	1.4822	1.4869	1.4916
1.5190	1.5244	1.5292	1.5339	1.5386
1.5672	1.5720	1.5768	1.5816	1.5864
1.6154	1.6203	1.6252	1.6300	1.6349
1.6644	1.6693	1.6742	1.6792	1.6841
1.7140	1.7191	1.7241	1.7291	1.7341
1.7645	1.7695	1.7746	1.7797	1.7848
1.8156	1.8208	1.8259	1.8311	1.8363
1.8675	1.8727	1.8779	1.8832	1.8884
1.9201	1.9254	1.9307	1.9360	1.9413
1.9734	1.9788	1.9342	1.9895	1.9949
2.0275	2.0329	2.0384	2.0438	2.0492
2.0822	2.0878	2.0922	2.0988	2.1041

Areas of Circles

D.	0	1	2	3	4
76	2.1099	2.1155	2.1211	2.1266	2.1322
77	2.1658	2.1715	2.1771	2.1827	2.1884
78	2.2225	2.2282	2.2339	2.2396	2.2453
79	2.2798	2.2856	2.2914	2.2972	2.3029
80	2.3379	2.3437	2.3496	2.3555	2.3612
81	2.3967	2.4026	2.4085	2.4145	2.4204
82	2.4562	2.4622	2.4682	2.4742	2.4830
83	2.5165	2.5226	2.5287	2.5347	2.5408
84	2.5775	2.5837	2.5898	2.5960	2.6021
85	2.6393	2.6455	2.6517	2.6579	2.6642
86	2.7017	2.7080	2.7143	2.7206	2.7269
87	2.7649	2.7713	2.7776	2.7840	2.7904
88	2.8283	2.8353	2.8417	2.8489	2.8549
89	2.8935	2.9000	2.9065	2.9131	2.9196
90	2.9589	2.9655	2.9721	2.9787	2.9853
91	3.0250	3.0327	3.0383	3.0450	3.0517
92	3.0919	3.0986	3.1053	3.1121	3.1188
93	3.1595	3.1694	3.1739	3.1799	3.1867
94	3.2278	3.2346	3.2415	3.2484	3.2553
95	3.2968	3.3078	3.3107	3.3177	3.3246
96	3.3666	3.3736	3.3806	3.3877	3.3947
97	3.4371	3.4442	3.4513	3.4584	3.4655
98	3.5083	3.5155	3.5226	3.5297	3.5330
99	3.5803	3.5874	3.5948	3.6020	3.6093
100	3.6530	3.6603	3.6676	3.6749	3.6823

in Malt Buſhels.

5	6	7	8	9
2.1378	2.1434	2.1490	2.1546	2.1602
2.1940	2.1997	2.2057	2.2111	2.2168
2.2510	2.2568	2.2625	2.2682	2.2740
2.3088	2.3146	2.3204	2.3262	2.3320
2.3672	2.3731	2.3790	2.3849	2.3908
2.4264	2.4323	2.4382	2.4443	2.4502
2.4863	2.4923	2.4984	2.5044	2.5105
2.5469	2.5530	2.5591	2.5653	2.5714
2.6083	2.6145	2.6207	2.6269	2.6331
2.6704	2.6767	2.6829	2.6892	2.6945
2.7332	2.7396	2.7459	2.7522	2.7586
2.7968	2.8032	2.8096	2.8160	2.8224
2.8611	2.8676	2.8740	2.8805	2.8870
2.9261	2.9326	2.9392	2.9458	2.9523
2.9919	2.9985	3.0051	3.0117	3.0184
3.0583	3.0650	3.0717	3.0784	3.0852
3.1256	3.1323	3.1391	3.1459	3.1527
3.1935	3.2004	3.2072	3.2140	3.2209
3.2622	3.2691	3.2760	3.2820	3.2899
3.3316	3.3386	3.3456	3.3526	3.3596
3.4017	3.4088	3.4158	3.4229	3.4300
3.4726	3.4797	3.4869	3.4939	3.5012
3.5442	3.5514	3.5586	3.5658	3.5731
3.6165	3.6238	3.6311	3.6384	3.6457
3.6896	3.6969	3.7043	3.7117	3.7189

The Deſcription and Uſe of the preceding Table.

In this Table are eleven Columns; in the firſt you have the Diameter of any Circle from 12 to 100 Inches, and in the ſecond ſtands the Area of that Circle.

EXAMPLE I.

Let it be required to find the Area in Malt Buſhels, of that Circle whoſe Diameter is 36 Inches.

Find 36 in the firſt Column, and againſt that in the ſecond Column you'll find 0,4734; which ſignifies, that the Cylinder, whoſe Diameter is 36 Inches, will hold but ,4734 of a Buſhel of Malt upon an Inch.

EXAMPLE II.

Let it be required to find the Area of that Circle, whoſe Diameter is 97 Inches.

Find 97 in the firſt Column, and againſt that in the ſecond you'll find 3,4371, the Area required.

EXAMPLE III.

What's the Area of that Circle whoſe Diameter is 150 Inches?

Find 15 in the firſt Column, and againſt that in the ſecond you'll find 0,0822, which is the Area of that Circle whoſe Diameter is 15; but if you move the Comma two Places towards the Right-Hand, it will be 008,22, *i. e.* 8,22; the Area required.

EX-

EXAMPLE. IV.

What's the Area of that Circle whoſe Diameter is 42,6?

Find 42 Inches in the firſt Column, and ,6 at the Top; and in the Angle of Meeting you'll find 0,6629, the Area required.

EXAMPLE V.

What's the Area of that Circle, whoſe Diameter is 148?

Find 14 in the firſt Column, and ,8 at the Top; then in the Angle of Meeting you'll find 0,0800; but ſetting the Point two Places back, it will be 008,00, *i.e.* 8,00, the Area required.

EXAMPLE VI.

What's the Area of that Circle whoſe Diameter is 148,5?

Find by the laſt Example the Area of 149, which is 8,11, their Difference is ,11, and Half their Difference is ,055; which added to 8,00 is 8,055, the Area of 148,5 required.

EXAMPLE VII.

What's the Area of that Circle whoſe Diameter is 123,3?

1. Find the Area of 123, which is 5,52
2. Find the Area of 124, which is 5,61

Their Difference is ,09, which multiplied by ,3 gives ,027, and that added to 5,52 makes 5,547, the Area required.

EXAMPLE VIII.

What's the Area of that Circle whoſe Diameter is 123,8?

1. Find the Area of 123, and that is - - - 5,52
2. Find the Area of 124, and that is - - - 5,61

Their Difference is - - - - - - - - - - - - 0,09

Which multiplied by ,8 produceth ,072, and this added to 5,52 gives 5.592, the Area required.

By theſe eight Examples it may ſufficiently appear, that the Area of any Circle from 12 to 100 Inches Diameter, may be found by Inſpection; and that the Area of any Circle from 12 to 1000 Inches Diameter, may by the ſame Tables be found near enough in Practice.

A TABLE

A
TABLE
TO
Gauge right-lined FIGURES;
AS
Squares, Triangles, Trapezia's, &c.

Giving the

Content of the Squares from 21 to 120 Inches in Breadth, and from 30 to 310 in Length, by Inſpection; and conſequently of any other Length and Breadth, by Addition.

20	21	22	23	24	25
30	.2930	.3069	.3209	.3349	.3488
40	.3907	.4093	.4279	.4465	.4651
50	.4884	.5116	.5448	.5581	.5813
60	.5860	.6139	.6418	.6647	.6977
70	.6837	.7162	.7488	.7813	.8139
80	.7814	.8186	.8558	.8913	.9302
90	.8790	.9209	.9627	1.0046	1.0465
100	.9767	1.0232	1.0697	1.1162	1.1628
110	1.0744	1.1256	1.1567	1.2279	1.2790
120	1.1720	1.2279	1.2837	1.3395	1.3953
130	1.2697	1.3302	1.3967	1.4511	1.5110
140	1.3674	1.4325	1.4976	1.5628	1.9279
150	1.4651	1.5349	1.6046	1.6744	1.7442
160	1.5628	1.6372	1.7116	1.7860	1.8604
170	1.6004	1.7395	1.8186	1.8970	1.9767
180	1.7580	1.8418	1.9255	2.0093	2.0930
190	1.8557	1.9422	2.0325	2.1209	2.2093
200	1.9534	2.0465	2.1395	2.2325	2.3256
210	2.0511	2.1488	2.2465	2.3442	2.4418
220	2.1488	2.2511	2.3534	2.4558	2.5581
230	2.2465	2.4535	2.4604	2.5674	2.6744
240	2.3442	2.5558	2.5674	2.6790	2.7907
250	2.4418	2.5581	2.6744	2.7906	2.9069
260	2.5395	2.6604	2.7831	2.9023	3.0232
270	2.6372	2.7628	2.8883	3.0139	3.1395
280	2.7348	2.8651	2.9953	3.1256	3.2558
290	2.8325	2.9674	3.1023	3.2372	3.3721
300	2.9302	2.0697	3.2093	3.3488	3.4883
1	.0097	.0102	.0107	.0111	.0116
2	.0195	.0204	.0214	.0223	.0232
3	.0293	.0307	.0321	.0335	.0348
4	.0390	.0390	.0428	.0446	.0465
5	.0488	.0488	.0535	.0558	.0581
6	.0586	.0586	.0642	.0664	.0697
7	.0683	.0683	.0749	.0781	.0813
8	.0781	.0781	.0856	.0893	.0930
9	.0879	.0879	.0963	.1004	.1046

26	27	28	29	30
.3626	.3767	.3907	.4046	.4186
.4836	.5023	.5209	.5395	.5581
.6046	.6279	.6511	.6744	.6976
.7256	.7535	.7814	.8093	.8372
.8465	.8590	.9116	.9441	.9767
.9674	1.0046	1.0420	1.0790	1.1162
1.0883	1.1302	1.1721	1.2139	1.2558
1.2093	1.2558	1.3023	1.3488	1.3951
1.3302	1.3814	1.4325	1.4837	1.5349
1.4511	1.5069	1.5628	1.6186	1.6744
1.5721	1.6325	1.6930	1.7534	1.8139
1.6930	2.7581	1.8232	1.8884	1.9535
1.8139	2.8837	1.9534	2.0235	2.0930
1.9349	2.0090	2.0837	2.1581	2.2325
2.0358	2.1348	2.2139	2.2930	2.3721
2.1766	2.2604	2.3441	2.4279	2.5116
2.2976	2.3860	2.4744	2.5628	2.6511
2.4786	2.5116	2.6046	2.6976	2.7906
2.5395	2.6372	2.5348	2.8325	2.9302
2.6604	2.7628	2.8651	2.9674	3.0697
2.7814	2.8884	2.9953	3.1023	3.2093
2.9023	3.0139	2.1256	3.2372	3.3488
3.0232	3.1395	2.2558	3.3721	3.4883
3.1442	3.2651	3.3860	3.5069	3.6279
3.2651	3.3907	3.5163	3.6418	3.7674
3.3860	3.5163	3.6465	3.7767	3.9069
3.5069	3.6418	3.7767	3.9116	4.0465
3.6279	3.7674	3.9069	4.0465	4.1860
.0120	.0125	.0130	.0135	.0139
.0242	.0251	.0260	.0269	.0279
.0362	.0376	.0390	.0404	.0418
.0482	.0502	.0521	.0539	.0558
.0604	.0621	.0651	.0674	.0697
.0725	.0753	.0781	.0809	.0837
.0846	.0859	.0911	.0944	.0976
.0967	.1004	.1042	.1079	.1116
.1088	.1130	.1172	.1213	.1255

	31	32	33	34	35
30	.4325	.4465	.4604	.4744	.4883
40	.5767	.5953	.6139	.6325	.6511
50	.7209	.7442	.7674	.7907	.8139
60	.8651	.8930	.9209	.9488	.9767
70	1.0093	1.0418	1.0744	1.1069	1.1395
80	1.1535	1.1907	1.2279	1.2651	1.3023
90	1.2976	1.3395	1.3814	1.4232	1.4651
100	1.4418	1.4883	1.5349	1.5813	1.6279
110	1.5860	1.6372	1.6883	1.7395	1.7907
120	1.7302	1.7860	1.8418	1.8977	1.9535
130	1.8744	1.9349	1.9953	2.0558	2.1162
140	2.0186	2.0837	2.1488	2.2139	2.2790
150	2.1628	2.2325	2.3023	2.3721	2.4418
160	2.3069	2.3814	1.4558	2.5023	2.6046
170	2.4511	2.5302	2.6093	2.6884	2.7674
180	2.5953	2.6790	1.7628	2.8465	2.9302
190	2.7395	2.8279	2.9162	3.0046	3.0930
200	2.8837	2.9767	3.0697	3.2628	3.2558
210	3.0279	3.1256	3.2232	3.3209	3.4186
220	3.1720	3.2744	3.3767	3.4791	3.5814
230	3.3162	3.4232	3.5302	3.6342	3.7442
240	3.4264	3.5721	3.6837	3.7923	3.8069
250	3.6046	3.7209	3.8372	3.9534	4.0697
260	3.7488	3.8697	3.9907	4.1116	4.2321
270	4.8930	4.0186	4.1442	4.3697	4.3952
280	4.0372	4.1674	4.2976	4.4279	4.5581
290	4.1814	4.3163	4.4516	4.5860	4.7200
300	4.3256	4.4651	4.6046	4.7442	4.8837
1	.0141	.0148	.0153	.0158	.0162
2	.0288	.0297	.0307	.0316	.0325
3	.0432	.0466	.0460	.0474	.0488
4	.0576	.0595	.0614	.0632	.0651
5	.0720	.0744	.0767	.0790	.0813
6	.0865	.0893	.0921	.0948	.0976
7	.1009	.1042	.1074	.1107	.1139
8	.1153	.1190	.1228	.1265	.1302
9	.1297	.1339	.1381	.1423	.1465

36	37	38	39	40
.5023	.5163	.5302	.5442	.5581
.6697	.6883	.7069	.7246	.7441
.8372	.8604	.8837	.9069	.9302
1.0046	1.0325	1.0604	1.0883	1.1163
1.1721	1.2024	1.2372	1.2097	1.2033
1.3395	1.3767	1.4139	1.4546	1.4884
1.5069	1.5488	1.5907	1.6325	1.6744
1.6744	1.7209	1.7674	1.8129	1.8604
1.8418	1.8930	1.9442	1.9953	2.0465
2.0093	2.0651	2.1209	2.1767	2.2325
2.1767	2.2372	2.2976	2.3581	2.4186
2.3442	2.4093	2.4744	2.5395	2.6046
2.5162	2.5814	2.6511	2.7209	2.7900
2.6791	2.7504	2.8279	2.9023	2.9767
2.8465	2.9255	3.0046	3.0837	3.1627
3.0139	2.9767	3.1814	3.2651	3.3488
3.1849	3.2697	3.3581	3.4465	3.5349
3.3488	3.4418	3.5348	3.6279	3.7209
3.5162	3.6139	3.7116	3.8093	3.9069
3.6837	3.7860	3.8883	3.9907	4.0930
3.8511	3.9581	4.0651	4.1721	4.2790
4.0186	4.1302	4.2418	4.3535	4.4465
4.1860	4.3023	4.4186	4.5348	4.6511
4.3535	4.4744	4.5953	4.7162	4.8372
4.5209	4.6465	4.9720	4.8976	5.0232
4.6883	4.8186	4.7488	5.0790	5.2093
4.8558	4.9906	5.1255	5.2604	5.3953
5.0232	5.1627	5.3023	5.4418	5.8113
.0167	.0172	.0176	.0181	.0186
.0335	.0344	.0353	.0362	.0372
.0502	.0516	.0530	.0544	.0558
.0669	.0688	.0707	.0725	.0744
.0837	.0860	.0883	.0907	.0933
.1004	.1032	.1060	.1088	.1116
.1172	.1202	.1237	.1269	.1202
.1339	.1376	.1414	.1454	.1488
.1507	.1548	.1590	.1632	.1674

	41	42	43	44	45
30	.5720	.5860	.0000	.6139	.6279
40	.7628	.7814	.8000	.8186	.8372
50	.9535	.9767	1.0000	1.0232	1.0455
60	1.1442	1.1721	1.2000	1.2270	1.2558
70	1.3348	1.3674	1.4001	1.4325	1.4651
80	1.5255	1.5628	1.6000	1.6372	1.6744
90	1.7162	1.7581	1.8000	1.8418	1.8837
100	1.9069	2.9535	2.0000	[illegible].0465	2.0930
110	2.0976	2.1488	2.2000	2.2511	2.3023
120	2.2884	2.3442	2.4000	2.4558	2.5126
130	2.4790	2.5395	2.6000	2.6604	2.7209
140	2.6697	2.7348	2.8000	2.8651	2.9302
150	2.8604	2.9302	3.0000	3.0697	3.1395
160	3.0511	3.1255	3.2000	3.2744	3.3488
170	3.2418	3.3289	3.4000	3.4790	3.5581
180	3.4325	3.5162	3.6000	3.6837	3.7614
190	3.6232	3.7116	3.8000	3.8883	3.9767
200	3.8139	3.9069	4.0000	4.0930	4.1860
210	4.0046	4.1023	4.2000	4.2976	4.3953
220	4.1953	4.2976	4.4000	4.5023	4.6046
230	4.3860	4.4930	4.6000	4.7069	4.8139
240	4.5767	4.6883	4.8000	4.9116	5.0232
250	4.7674	4.8837	5.0000	5.1162	5.2325
260	4.9581	5.0790	5.2000	5.3209	5.4418
270	5.1488	5.2744	5.4000	5.5255	5.6511
280	5.3395	5.4697	5.6000	5.7347	5.8604
290	5.5302	5.6651	5.8000	5.9347	6.0697
300	5.7209	5.8604	6.0000	6.1394	6.2790
1	.0190	.0195	.0200	.0204	.0209
2	.0381	.0390	.0400	.0409	.0418
3	.0572	.0586	.0600	.0613	.0628
4	.0762	.0781	.0800	.0818	.0837
5	.0953	.0976	.1000	.1023	.1046
6	.1144	.1172	.1200	.1228	.1265
7	.1335	.1367	.1400	.1432	.1465
8	.1525	.1562	.1600	.1637	.1674
9	.1716	.1758	.1800	.1841	.1883

46	47	48	49	50
.6418	.6558	.6697	.6837	.6976
.8558	.8744	.8930	.9116	.9302
1,0697	1.0930	1.1762	1.1395	1.1627
1.2837	1.3116	1.3395	1.3674	1.3953
1.4970	1.5302	1.5651	1.5953	1.6279
1.7116	1.7488	1.7860	1.8232	1.8604
1.9255	1.9674	2.0093	2.0511	2.0930
2.1395	2.1860	2.2325	2.2790	2.3255
2.3534	2.4046	2.4458	2.5069	2.5581
2.5674	2.6232	2.6790	2.7348	2.7906
2.7813	2.8418	2.9023	2.9618	3.0232
2.9553	3.0604	3.1255	3.1807	3.2558
3.2093	3.2790	3.3488	3.4186	3.4883
3.4232	3.4976	3.5720	3.6465	3.7269
3.6372	3.7162	3.7953	3.8744	3.9524
3.8511	3.9348	4.0186	4.1022	4.1860
4.0651	4.1534	4.2418	4.3202	4.4186
4.2790	4.3720	4.4651	4.5581	4.6511
4.4930	4.5906	4.6883	4.7860	4.8837
4.7069	4.8093	4.9116	5.0149	5.1162
4.9209	5.0279	5.1348	5.2419	5.3488
5.1348	5.2465	5.3581	5 4699	5.5813
5.3488	5.4651	5.5813	5.6976	5.8139
5.5627	5.6847	5.8046	5.9255	5.0465
5.7767	5.9055	6.0279	6.1534	6.2790
5.9906	6.1019	6.2511	6.3814	6.5116
6.2046	6.3305	6.4744	6.6093	6.7441
6.4186	6.5581	6.6976	6.8372	6.9767
.0214	.0218	.0223	.0228	.0232
.0427	.0437	.0446	.0455	.0465
.0641	.0655	.0669	.0683	.0697
.0855	.0874	.0893	.0911	.0930
.1069	.1093	.1116	.1139	.1162
.1283	.1311	.1339	.1367	.1395
.1497	.1530	.1565	.1595	.1628
.1711	.1748	.1786	.1823	.1860
.1925	.1967	.2000	.2051	.2093

	51	52	53	54	55
30	.7116	.7255	.7395	.7534	.7674
40	.9488	.9674	.9860	1.0046	1.0232
50	1.1862	1.2093	1.2325	1.2558	1.2790
60	1.4232	1.4511	1.4790	1.5069	1.5348
70	1.6604	1.6930	1.7255	1.7581	1.7906
80	1.8976	1.9348	1.9720	2.0093	2.0465
90	2.1348	2.1767	2.2180	2.2604	2.3023
100	2.3720	2.4186	2.4651	2.5116	2.5581
110	2.6093	2.6604	2.7116	2.7627	2.8139
120	2.8465	2.9023	2.9581	3.0139	3.0697
130	3.0837	3.1441	3.2046	3.2651	3.3255
140	3.3209	3.3860	3.4511	3.5162	3.5813
150	3.5581	3.6279	3.6976	3.7647	3.8372
160	3.7953	3.8697	3.9441	4.0186	4.0930
170	4.0325	4.1116	4.1906	4.2697	4.3488
180	4.2697	4.3534	4.4372	4.5209	4.6406
190	4.5069	4.5953	4.6837	4.7720	4.8612
200	4.7441	4.8372	4.9302	5.0232	5.1162
210	4.9813	5.0790	5.1763	5.2740	5.3720
220	5.2186	5.3299	5.4232	5.5255	5.6279
230	5.4558	5.5627	5.6697	5.7767	5.8837
240	5.6930	5.8046	5.9162	6.0249	6.1495
250	5.9302	6.0465	6.1627	6.2790	6.3953
260	6.1674	6.2883	6.4093	6.5302	6.6511
270	6.4046	6.5302	6.6558	6.7813	6.9069
280	6.6418	6.7720	6.9023	7.0325	7.1627
290	6.8790	7.0139	7.1488	7.2837	7.4180
300	7.1162	7.2558	7.3953	7.5348	7.6744
1	.0234	.0242	.0246	.0251	.0255
2	.0474	.0483	.0493	.0502	.0511
3	.0711	.0725	.0739	.0753	.0767
4	.0948	.0967	.0986	.1004	.1023
5	.1186	.1209	.1232	.1255	.1279
6	.1423	.1451	.1479	.1483	.1535
7	.1660	.1693	.1725	.1758	.1790
8	.1897	.1934	.1972	.1909	.2046
9	.2134	.2176	.2218	.2260	.2302

56	57	58	59	60
.7813	.7953	.8093	.8232	.8372
1.0418	1.0604	1.0790	1.0976	1.1162
1.3023	1.3255	1.3488	1.3720	1.3953
1.5627	1.5906	1.6186	1.6485	1.6774
1.8237	1.8558	1.8883	1.9209	1.9534
2.0837	2.1209	2.1581	2.1953	2.2325
2.3441	2.3860	2.4279	2.4697	2.5116
2.6046	2.6511	2.6976	2.7441	2.7906
2.8651	2.9162	2.9674	3.0186	3.0697
3.1255	3.1813	3.2372	3.2930	3.3488
3.3860	3.4465	3.5069	3.5674	3.6279
3.6465	3.7116	3.7767	3.8418	3.9069
3.9069	3.9767	4.0465	4.1162	4.1860
4.1674	4.2418	4.3162	4.3906	4.4651
4.4279	4.5069	4.5860	4.6651	4.7441
4.6883	4.7720	4.8558	4.9395	5.0232
4.9488	5.0372	5.1255	5.2139	5.3023
5.2093	5.3023	5.3953	5.4883	5.5813
5.4697	5.5674	5.6651	5.7627	5.8604
5.7212	5.8325	5.9348	6.0372	6.1395
5.9816	6.0976	6.2046	6.3116	6.4186
6.2521	6.3627	6.4744	6.5860	6.6976
6.5126	6.6279	6.7441	6.8604	6.9767
6.7730	6.8930	7.0149	7.1348	7.2558
7.0330	7.1581	7.2887	7.4093	7.5348
7.2930	7.4232	7.5534	7.6837	7.8139
7.5534	7.6883	7.8232	7.9581	8.0929
7.8139	7.9534	8.0930	8.2325	8.3720
.0260	.0265	.0269	.0274	.0279
.0521	.0530	.0539	.0548	.0558
.0781	.0795	.0809	.0823	.0837
.1042	.1060	.1079	.1097	.1116
.1302	.1325	.1348	.1372	.1395
.1561	.1590	.1618	.1648	.1674
.1823	.1855	.1888	.1921	.1953
.2083	.2120	.2158	.2195	.2232
.2344	.2386	.2427	.2469	.2511

	61	62	63	64	65
30	.8511	.8651	.8790	.8930	.9069
40	1.1348	1.1534	1.1720	1.1906	1.2093
50	1.4186	1.4418	1.4651	1.4883	1.5116
60	1.7023	1.7302	1.7581	1.7860	1.8139
70	1.9860	2.0186	2.0511	2.0837	2.1162
80	2.2697	2.3069	2.3441	2.3813	2.4186
90	2.5534	2.5953	2.6372	2.6790	2.7209
100	2.8372	2.8837	2.9302	2.9767	3.0232
110	3.1209	3.1720	3.2232	3.2744	3.3255
120	3.4046	3.4804	3.5167	3.5720	3.6279
130	3.6883	3.7488	3.8096	3.8697	3.9302
140	3.9720	4.0372	4.1023	4.1674	4.2325
150	4.2558	4.3255	4.3953	4.4651	4.5348
160	4.5395	4.6139	4.6883	4.7629	4.8372
170	4.8232	4.9023	4.9813	5.0604	5.1395
180	5.1869	5.1906	5.2744	5.3581	5.4418
190	5.3906	5.4790	5.5674	5.6558	5.7465
200	5.6740	5.7641	5.8604	5.9534	6.0465
210	5.9581	6.0558	6.1534	6.2511	6.3488
220	6.2418	6.3441	6.4465	6.5488	6.6511
230	6.5255	6.6325	6.7395	6.8466	6.9534
240	6.8098	6.9209	7.0355	7.1441	7.2548
250	7.0930	7.2093	7.3255	7.4418	7.5577
260	7.3767	7.4976	7.6186	7.7395	7.8594
270	7.6604	7.7860	7.9116	8.0372	8.1627
280	7.9441	8.0744	8.2046	8.3348	8.4651
290	8.2279	8.3627	8.4976	8.6325	8.7674
300	8.5116	8.6511	8.7906	8.9302	9.0697
1	.0283	.0288	.0293	.0297	.0302
2	.0567	.0576	.0586	.0595	.0604
3	.0851	.0865	.0879	.0893	.0907
4	.1135	.1153	.1172	.1190	.1209
5	.1418	.1442	.1465	.1488	.1511
6	.1702	.1730	.1758	.1786	.1814
7	.1986	.2018	.2051	.2083	.2116
8	.2269	.2307	.2344	.2381	.2418
9	.2553	.2595	.2637	.2679	.2720

66	67	68	69	70
.9209	.9348	.9488	.9627	.9767
1.2279	1.2465	1.2651	1.2837	1.3023
1.5348	1.5581	1.5813	1.6046	1.6279
1.8418	1.8697	1.8976	1.9255	1.9534
2.1488	2.1813	2.2189	2.2465	2.2790
2.4558	2.4930	2.5302	2.5674	2.6046
2.7627	2.8046	2.8465	2.8883	2.9302
3.0697	3.1162	3.1627	3.2093	3.2558
3.3767	3.4279	3.4790	3.5302	3.5813
3.6837	3.7395	3.7953	3.8511	3.9069
3.9906	4.0511	4.1116	4.1720	4.2325
4.2976	4.3627	4.4278	4.4930	4.5587
4.6046	4.6744	4.7440	4.8139	4.8837
4.9116	4.9860	5.0604	5.1348	5.2093
5.2186	5.2976	5.3767	5.4558	5.5348
5.5255	5.6093	5.6930	5.7767	5.8664
5.8325	5.9209	6.0099	6.0976	6.1860
6.1395	6.2325	6.3225	6.4185	6.5116
6.4465	6.5441	6.6418	6.7395	6.8372
6.7534	6.8558	6.9581	7.0604	7.1627
7.0604	7.1674	7.2744	7.3813	7.4883
7.3674	7.4790	7.5906	7.7023	7.8139
7.6744	7.7906	7.9069	8.0232	8.1295
7.9813	8.1023	8.2232	8.3441	8.4653
8.2883	8.4139	8.5395	8.6651	8.7906
8.5953	8.7255	8.8550	8.9860	9.1162
8.9023	9.0327	9.1720	9.3069	9.4418
9.2093	9.3488	9.4883	9.6279	9.7674
.0307	.0311	.0316	.0320	.0325
.0614	.0623	.0632	.0641	.0651
.0920	.0935	.0948	.0962	.0976
.1228	.1246	.1265	.1283	.1302
.1535	.1558	.1581	.1604	.1628
.1842	.1869	.1897	.1925	.1953
.2148	.2181	.2218	.2246	.2279
.2455	.2493	.2530	.2567	.2604
.2762	.2804	.2846	.2888	.2903

	71	72	73	74	75
30	.9906	1.0046	1.0186	1.0325	1.0465
40	1.3209	1.3395	1.3581	1.3767	1.3953
50	1.6511	1.6744	1.6976	1.7209	1.7441
60	1.9813	2.0093	2.0372	2.0651	2.0930
70	2.3116	2.3441	2.3767	2.4063	2.4418
80	2.6418	2.6790	2.7162	2.7534	2.7906
90	2.9720	3.0139	3.0558	3.0976	3.1395
100	3.3023	3.3488	3.3953	3.4418	3.4883
110	3.6325	3.6837	3.7348	3.7860	3.8372
120	3.9627	4.0186	4.0744	4.1302	4.1861
130	4.2930	4.3534	4.4139	4.4744	4.5348
140	4.6232	4.6833	4.7534	4.8186	4.8837
150	4.9534	5.0232	5.0930	5.1627	5.2325
160	5.2837	5.3581	5.4325	5.5069	5.5813
170	5.6139	5.6930	5.7720	5.8511	5.9301
180	5.9441	6.0279	6.1116	6.1953	6.2790
190	6.2744	6.3622	6.4511	6.5395	6.6279
200	6.6046	6.6976	6.7906	6.8837	6.9767
210	6.9348	7.0325	7.1302	7.2790	7.3255
220	7.2651	7.3674	7.4897	7.5620	7.6744
230	7.5953	7.7023	7.8093	7.9162	8.0232
240	7.9255	8.0372	8.1488	8.2604	8.3720
250	8.2558	8.3720	8.4883	8.6046	8.7209
260	8.5860	8.7069	8.8279	8.9488	9.0697
270	8.9162	9.0418	9.1674	9.2930	9.4186
280	9.2465	9.3767	9.5069	9.6372	9.7674
290	9.5767	9.7116	9.8465	9.9813	10.1162
300	9.9069	10.0460	10.1860	10.3255	10.4651
1	.0330	.0334	.0339	.0344	.0348
2	.0660	.0669	.0679	.0688	.0697
2	.0990	.1004	.1018	.1032	.1046
4	.1321	.1339	.1358	.1376	.1395
5	.1651	.1674	.1697	.1721	.1744
6	.1981	.2009	.2037	.2065	.2093
7	.2311	.2344	.2356	.2406	.2442
8	.2642	.2679	.2716	.2753	.2790
9	.2972	.3014	.3056	.3097	.3139

76	77	78	79	80
1.0604	1.0744	1.0883	1.1023	1.1102
1.4139	1.4325	1.4511	1.4697	1.4883
1.7674	1.7906	1.8139	1.8372	1.8604
2.1209	2.1488	2.1767	2.2046	2.2325
2.4744	2.5069	2.5395	2.5720	2.6046
2.8279	2.8651	2.9023	2.9395	2.9767
3.1813	3.2232	3.2651	3.3069	3.3488
3.5348	3.5813	3.6279	3.6744	3.7209
3.8883	3.9395	3.9906	4.0418	4.0930
4.2418	4.2976	4.3534	4.4093	4.4657
4.5953	4.6558	4.7162	4.7767	4.8372
4.9488	5.0139	5.0790	5.1441	5.2093
5.3023	5.3720	5.4418	5.5116	5.5813
5.6558	5.7302	5.8046	5.8790	5.9534
6.0093	6.0883	6.1694	6.2465	6.3255
6.3627	6.4465	6.5302	6.6119	6.6976
6.7162	6.8046	6.8930	6.9813	7.0697
7.0697	7.1727	7.2558	7.3488	7.4418
7.4232	7.5209	7.6186	7.7162	7.8139
7.7767	7.8790	7.9813	8.0837	8.1860
8.1302	8.2371	8.3441	8.4511	8.5581
8.4837	8.6953	8.7069	8.8186	8.9302
8.8372	8.9534	9.0697	9.1860	9.3023
9.1906	9.3116	9.4325	9.5524	9.6744
9.5441	9.6697	9.7935	9.9209	10.0465
9.8976	10.0278	10.1581	10.2883	10.4186
10.2511	10.3860	10.5109	10.6558	10.7906
10.6046	10.7441	10.8837	11.0232	11.1627
.0353	.0358	.0362	.0367	.0372
.0707	.0717	.0725	.0734	.0744
.1060	.1074	.1088	.1102	.1116
.1414	.1432	.1451	.1469	.1488
.1767	.1790	.1813	.1837	.1860
.2121	.2148	.2176	.2204	.2232
.2474	.2506	.2539	.2572	.2604
.2828	.2865	.2902	.2939	.2976
.3181	.3223	.3265	.3307	.3248

	81	82	83	84	85
30	1.1302	1.1441	1.1581	1.1720	1.1860
40	1.5069	1.5255	1.5441	1.5627	1.5813
50	1.8837	1.9069	1.9302	1.9534	1.9767
60	2.2604	2.2882	2.3167	2.3441	2.3720
70	2.6372	2.6697	2.7023	2.7348	2.7674
80	3.0139	3.0511	3.0883	3.1255	3.1627
90	3.3906	3.4325	3.4741	3.5162	3.5581
100	3.7674	3.8139	3.8604	3.9069	3.9534
110	4.1441	4.1953	4.2465	4.2976	4.3488
120	4.5209	4.5167	4.6325	4.6883	4.7441
130	4.8976	4.9581	5.0186	5.0790	5.1395
140	5.2744	5.3395	5.4046	5.4697	5.5348
150	5.6511	5.7209	5.7906	5.8604	5.9302
160	6.0279	6.1023	6.1767	6.2511	6.3255
170	6.4046	6.4837	6.5627	6.6418	6.7209
180	6.7813	6.8651	6.9488	7.0325	7.1162
190	7.1581	7.2465	7.3347	7.4232	7.5116
200	7.5348	7.6279	7.7209	7.8139	7.9069
210	7.9116	8.0093	8.1069	8.2046	8.3023
220	8.2882	8.3906	8.4930	8.5953	8.6976
230	8.6651	8.7720	8.8790	8.9860	9.0930
240	9.0413	9.1534	9.2651	9.3767	9.4883
250	9.4186	9.5348	9.6511	9.7674	9.8837
260	9.7953	9.9162	10.0372	10.1581	10.2793
270	10.1720	10.2976	10.4232	10.5488	10.6744
280	10.5488	10.6790	10.8093	10.9395	11.0697
290	10.9255	11.0604	11.1953	11.3303	11.4651
300	11.3023	11.4418	11.5813	11.7209	11.8604
1	.0376	.0381	.0386	.0390	.0395
2	.0753	.0761	.0772	.0781	.0790
3	.1130	.1144	.1158	.1172	.1186
4	.1507	.1525	.1544	.1562	.1581
5	.1883	.1900	.1930	.1953	.1976
6	.2260	.2288	.2316	.2344	.2372
7	.2637	.2669	.2702	.2735	.2769
8	.3014	.3051	.3088	.3125	.3162
9	.3390	.3432	.3474	.3516	.3558

86	87	88	89	90
1.2000	1.2139	1.2279	1.2418	1.2558
1.6000	1.6189	1.6372	1.6558	1.6744
2.0000	2.0232	2.0465	2.0697	2.0930
2.4000	2.4279	2.4558	2.4837	2.5116
2.8000	2.8325	2.8652	2.8976	2.9302
3.2000	3.2372	3.2744	3.3116	3.3488
3.6000	3.6418	3.6837	3.7255	3.7674
4.0000	4.0465	4.0930	4.1395	4.1860
4.4000	4.4511	4.5023	4.5534	4.6046
4.8000	4.8558	4.9116	4.9674	5.0232
5.2000	5.2604	5.3209	5.3813	5.4418
5.6000	5.9651	5.7302	5.7953	5.8604
6.0000	6.0679	6.1395	6.2093	6.2790
6.4000	6.4744	6.5488	6.6232	6.6976
6.8000	6.8760	6.9581	7.0372	7.1162
7.2000	7.2837	7.3974	7.4511	7.5348
7.6000	7.6883	7.7767	7.8651	7.9534
8.0000	8.0930	8.1860	8.2790	8.3720
8.4000	8.4978	8.5953	8.6930	8.7906
8.8000	8.9023	9.0046	9.1069	9.2093
9.2000	9.3069	9.4139	9.5209	9.6279
9.6000	9.7016	9.8232	9.9348	10.0465
10.0000	10.1162	10.2325	10.3488	10.4652
10.4000	10.5209	10.6418	10.7627	10.8837
10.8000	10.9255	11.0511	11.1767	11.3023
11.2000	11.3302	11.4604	11.5906	11.7209
11.6000	11.7348	11.8697	11.9046	12.1395
12.0000	12.1395	12.2790	12.4186	12.5581
.0400	.0404	.0409	.0413	.0418
.0800	.0809	.0818	.0828	.0832
.1200	.1214	.1227	.1242	.1255
.1600	.1619	.1637	.1655	.1674
.2000	.2023	.2046	.2066	.2093
.2400	.2428	.2455	.2483	.2511
.2800	.2832	.2865	.2897	.2930
.3200	.3237	.3274	.3311	.3348
.3600	.3642	.3683	.3725	.3767

	91	92	93	94	95
30	1.2695	1.2837	1.2976	1.3116	1.3255
40	1.6936	1.7171	1.7302	1.7488	1.7674
50	2.1162	2.1395	2.1627	2.1866	2.2093
60	2.5395	2.5674	2.5953	2.6232	2.6511
70	2.9627	2.9953	3.0279	3.0604	3.0936
80	3.3860	3.4232	3.4604	3.4970	3.5348
90	3.8093	3.8512	3.8939	3.9348	3.9767
100	4.2325	4.2760	4.3255	4.3720	4.4186
110	4.6558	4.7069	4.7581	4.8093	4.8604
120	5.0790	5.1748	5.1906	5.2465	5.3023
130	5.5023	5.5627	5.6232	5.6830	5.7441
140	5.9255	5.9906	6.0558	6.1209	6.1860
150	6.3488	6.4186	6.4883	6.5581	6.6279
160	6.7720	6.8465	6.9209	6.9953	7.0697
170	7.1953	7.2744	7.3534	7.4325	7.5116
180	7.6186	7.7022	7.7860	7.8697	7.9534
190	8.0418	8.1202	8.2186	8.3069	8.3953
200	8.4651	8.5813	8.6512	8.7441	8.8373
210	8.8883	8.9860	9.0837	9.1813	9.2790
220	9.3116	9.4139	9.5162	9.6186	9.7209
230	9.7348	9.8418	9.9488	10.0558	10.1627
240	10.1581	10.2697	10.3813	10.4930	10.6046
250	10.5813	10.6976	10.8139	10.9302	11.0465
260	11.0047	11.1125	11.2465	11.3670	11.4883
270	11.4279	11.5534	11.6790	11.8040	11.9302
280	11.8511	11.9813	12.1106	12.2418	12.3720
290	12.2544	12.4093	12.5444	12.6790	12.8139
300	12.6976	12.8372	12.9767	13.1162	13.2558
1	.0423	.0427	.0432	.0437	.0442
2	.0846	.0858	.0865	.0874	.0883
3	.1269	.1283	.1297	.1311	.1325
4	.1693	.1717	.1730	.1748	.1767
5	.2116	.2139	.2162	.2186	.2209
6	.2539	.2567	.2595	.2623	.2651
7	.2962	.2995	.3028	.3060	.3093
8	.3386	.3423	.3460	.3497	.3534
9	.3809	.3851	.3893	.3934	.3976

96	97	98	99	100
1.3395	1.3534	1.3674	1.3813	1.3953
1.7860	1.8046	1.8232	1.8418	1.8604
2.2325	2.2558	2.2790	2.3023	2.3258
2.6790	2.7069	2.7348	2.7627	2.7907
3.1255	3.1581	3.1906	3.2232	3.2558
3.5720	3.6093	3.6465	3.6837	3.7209
4.0186	4.0604	4.1023	4.1441	4.1860
4.4651	4.5116	4.5581	4.6046	4.6511
4.9116	4.9627	5.0139	5.0651	5.1162
5.3581	5.4139	5.4697	5.5259	5.5813
5.8046	5.8651	5.9255	5.9860	6.0465
6.2511	6.3162	6.3813	6.4465	6.5116
6.6976	6.7674	6.8372	6.9069	6.9767
7.1441	7.2186	7.2930	7.3674	7.4418
7.5906	7.6697	7.7488	7.8279	7.9069
8.0372	8.1209	8.2046	8.2886	8.3720
8.4837	8.5720	8.6604	8.7488	8.8372
8.9302	9.0232	9.1162	9.2093	9.3023
9.3767	9.4744	9.5720	9.6679	9.7674
9.8232	9.9255	10.0279	10.1302	10.2325
10.2697	10.3767	10.4837	10.5906	10.6976
10.7162	10.8279	10.9391	11.0511	11.1627
11.1627	11.2790	11.3953	11.5116	11.6279
11.6092	11.7302	11.8351	11.9720	12.0930
12.0558	12.1813	12.3069	12.4325	12.5581
12.5023	12.6325	12.7627	12.8930	13.0232
12.9488	13.0837	13.2186	13.3534	13.4883
13.3952	13.5348	13.6744	13.8139	13.9534
.0446	.0451	.0455	.0460	.0465
.0893	.0902	.0911	.0921	.0930
.1339	.1353	.1367	.1388	.1395
.1786	.1804	.1823	.1842	.1860
.2232	.2255	.2279	.2302	.2325
.2679	.2707	.2735	.2762	.2790
.3125	.3158	.3190	.3223	.3255
.3572	.3609	.3646	.3683	.3720
.4018	.4060	.4102	.4144	.4186

	101	102	103	104	105
30	1.4093	1.4232	1.4372	1.4511	1.4651
40	1.8790	1.8976	1.9162	1.9348	1.9534
50	2.3488	2.3720	2.3958	2.4186	2.4418
60	2.8186	2.8465	2.8744	2.9023	2.9302
70	3.2883	3.3209	3.3354	3.3866	3.4189
80	3.7581	3.7953	3.8325	3.8697	3.9069
90	4.2279	4.2697	4.3119	4.3534	4.3953
100	4.6976	4.7441	4.7909	4.8372	4.8837
110	5.1674	5.2180	5.2697	5.3209	5.3720
120	5.6372	5.6930	5.7488	5.8046	5.8604
130	6.1069	6.1674	6.2279	6.2883	6.3488
140	6.5767	6.6418	6.7069	6.7720	6.8372
150	7.0465	7.1102	7.1860	7.2550	7.3256
160	7.5162	7.5906	7.6651	7.7395	7.8139
170	7.9860	8.0651	8.1441	8.2232	8.3023
180	8.4558	8.5395	8.6232	8.7069	8.7907
190	8.9255	9.0139	9.1023	9.1906	9.2790
200	9.3953	9.4883	9.5813	9.6744	9.7674
210	9.8651	9.9627	10.0060	10.1581	10.2558
220	10.3249	10.4372	10.5395	10.6418	10.7442
230	10.8049	10.9116	11.0186	11.1255	11.2325
240	11.2744	11.3860	11.4976	11.6093	11.7206
250	11.7442	11.8604	11.9767	12.0930	12.2093
260	12.2139	12.3348	12.4558	12.5763	12.6976
270	12.6832	12.8093	12.9345	13.0604	13.1860
280	13.1535	13.2837	13.4139	13.5441	13.7446
290	13.6232	13.7581	13.8930	14.0279	14.1627
300	14.0930	14.2325	14.3721	14.5116	14.6511
1	.0469	.0474	.0479	.0483	.0488
2	.0939	.0948	.0958	.0967	.0976
3	.1409	.1423	.1437	.1451	.1465
4	.1879	.1897	.1916	.1935	.1953
5	.2348	.2372	.2395	.2418	.2442
6	.2818	.2846	.2874	.2902	.2930
7	.3288	.3321	.3353	.3386	.3418
8	.3758	.3795	.3832	.3869	.3907
9	.4228	.4269	.4311	.4353	.4395

106	107	108	109	110
1.4790	1.4930	1.5062	1.5209	1.5349
1.9721	1.9907	2.0092	2.0278	2.0465
2.4651	2.4883	2.5116	2.5348	2.5581
2.9581	2.9860	3.0139	3.0418	3.0697
3.4511	3.4837	3.5162	3.5488	3.5814
3.9442	3.9814	4.0186	4.0558	4.0930
4.4372	4.4790	4.5209	4.5628	4.6046
4.9302	4.9767	5.0232	5.0697	5.1163
5.4232	5.4744	5.5255	5.5767	5.6279
5.9163	5.9721	6.0279	6.0837	6.1395
6.4093	6.4697	6.5302	6.5907	6.6511
6.9023	6.9674	7.0325	7.0976	7.1628
7.3953	7.4651	7.5348	7.6046	7.6744
7.8883	7.9628	8.0372	8.1116	8.1860
8.3814	8.4604	8.5395	8.6186	8.6976
8.8744	8.9581	9.0418	9.1256	9.2093
9.3674	9.4558	9.5442	9.6325	9.7209
9.8604	9.9534	10.0465	10.1395	10.2325
10.3534	10.4511	10.5488	10.6465	10.7442
10.8465	10.9488	11.0511	11.1535	11.2558
11.3395	11.4465	11.5535	11.6604	11.7674
11.8325	11.9442	12.0558	12.1674	12.2790
12.3255	12.4418	12.5581	13.6744	12.7907
12.8186	12.9395	13.0604	14.1814	13.3023
12.3116	13.4372	13.5628	13.6883	13.8139
13.8046	13.9348	14.0651	14.1953	14.3256
14.2976	14.4325	14.5674	14.7023	14.8372
14.7907	14.9302	15.0697	15.2093	15.3488
.0493	.0978	.0502	.0507	.0511
.0986	.0995	.1004	.1014	.1023
.1479	.1493	.1506	.1521	.1535
.1972	.1991	.2009	.2028	.2046
.2465	.2488	.2511	.2535	.2558
.2958	.2986	.3014	.3042	.3069
.3451	.3483	.3516	.3549	.3581
.3944	.3981	.4018	.4056	.4093
.4437	.4479	.4521	.4563	.4604

	111	112	113	114	115
30	1.5488	1.5628	1.5767	1.4906	1.6046
40	2.0651	2.0837	2.1023	2.1209	2.1395
50	2.5814	2.6046	2.6279	2.6511	2.6744
60	3.0976	3.1256	3.1534	3.1813	3.2093
70	3.6139	3.6465	3.6790	3.7110	3.7441
80	4.1302	4.1674	4.2046	4.2418	4.2790
90	4.6465	4.6883	4.7302	4.7720	4.8139
100	5.1628	5.2093	5.2558	5.3023	5.3488
110	5.6790	5.7303	5.7813	5.8325	5.8837
120	6.1953	6.2511	6.3069	6.3627	6.4186
130	6.7116	6.7721	6.8325	6.8930	6.9534
140	7.2279	7.2930	7.3581	7.4232	7.4883
150	7.7442	7.8139	7.8137	7.9534	8.0232
160	8.2604	8.3348	8.4093	8.4837	8.5581
170	8.7767	8.8558	8.9348	9.0139	9.0930
180	9.2930	9.3767	9.4604	9.5441	9.6279
190	9.8093	9.8976	9.9860	10.0744	10.1627
200	10.3256	10.4186	10.5116	10.6046	10.6976
210	10.8418	10.9395	11.0372	11.1348	11.2325
220	11.3581	11.4604	11.5627	11.6651	11.7674
230	11.8744	11.9814	12.0883	12.1953	12.3023
240	12.3906	12.5023	12.6139	12.7255	12.8372
250	12.9069	13.0232	13.1395	13.2558	13.3720
260	13.4232	13.5442	13.6651	13.7860	13.9069
270	13.9395	14.0651	14.1906	14.3162	14.4418
280	14.4458	14.5860	14.7162	14.8465	14.9767
290	14.9721	15.1069	15.2418	15.3767	15.5116
300	15.4883	15.6279	15.7674	15.9069	15.0465
1	.0516	.0521	.0525	.0530	.0535
2	.1032	.1042	.1051	.1060	.1069
3	.1548	.1562	.1576	.1590	.1604
4	.2065	.2083	.2102	.2121	.2136
5	.2581	.2604	.2628	.2651	.2674
6	.3097	.3125	.3125	.3181	.3209
7	.3614	.3646	.3679	.3711	.3744
8	.4130	.4167	.4204	.4242	.4279
9	.4646	.4688	.4772	.4730	.4814

116	117	118	119	120
1.6186	1.0325	1.6465	1.6604	1.6744
2.1581	2.1767	2.1953	2.2139	2.2325
2.6976	2.7209	2.7411	2.7676	2.7906
3.2372	3.2651	3.2930	3.3209	3.3488
3.7767	3.8093	3.8418	3.8744	3.9069
4.3162	4.3534	4.3906	4.4279	4.4651
4.8558	4.8976	4.6395	4.9813	5.0232
5.3953	5.4418	5.4883	5.5348	5.5813
5.9348	5.9860	6.0372	6.0883	6.1395
6.4744	6.5302	6.5860	6.6418	6.6976
7.0139	7.0744	7.1348	7.1953	7.2558
7.5534	7.6186	7.6837	7.7488	7.8139
8.0930	8.1627	8.2825	8.3023	8.3720
8.6325	8.7069	8.7813	8.8558	8.9302
9.1720	9.2511	9.3302	9.4093	9.4883
9.7116	9.7953	9.8790	9.9627	10.0465
10.2511	10.3395	10.4280	10.5162	10.6046
10.7906	10.8837	10.9767	11.0697	11.1627
11.3302	11.4279	11.5255	11.6232	11.7209
11.8697	11.9720	12.0744	12.1767	12.2790
12.4093	12.5162	12.6234	12.7302	12.8372
12.9488	13.0604	13.1720	13.2837	13.3953
13.4883	13.6046	13.7219	13.8372	13.9534
14.0279	14.1148	14.2696	14.3906	14.5116
14.5674	14.6930	14.8180	14.9441	15.0097
15.1069	15.2372	15.3674	15.4976	15.6279
15.6465	15.7813	15.9164	16.0511	16.1860
16.1860	16.3255	16.4651	16.6046	16.7441
.0539	.0544	.0548	.0553	.0558
.1079	.1088	.1097	.1107	.1116
.1618	.1632	.1646	.1660	.1674
.2158	.2176	.2195	.2214	.2232
.2697	.2721	.2744	.2707	.2790
.3237	.3265	.3293	.3321	.3348
.3776	.3809	.3842	.3874	.3907
.4316	.4353	.4390	.4428	.4465
.4855	.4897	.4629	.4081	.4023

To Gauge a Couch which lies in the Form of a Parallelogram.

RULE.

Find the Breadth in the Top of the Table, and the Length in the firſt Column, and in the Angle of Meeting, you'll have the Content in Malt Buſhels at one Inch deep.

EXAMPLE I.

Let a Couch be propoſed, whoſe Length is 199 Inches, and Breadth 99, and the Area be required.

Look for 99 in the Top of the Table, and under that, and againſt 190, you'll find } 8,7488
And againſt 9 you'll find - - - - - - - ,4144
Their Sum is - - - - - - - - - - - 9,1632 the Area required; which, if you multiply by the Depth, produceth the whole Content in Malt Buſhels.

EXAMPLE II.

Admit the Length of a Couch to be 559 Inches, and Breadth 342, what's the Area?

1. Look for 100 at the Top, and under it, and againſt 300, you'll find - - - } 13,9534
Againſt 200 you'll find - - - - - - - 9,3023
Againſt 50 you'll find - - - - - - - - 2,3258
Againſt 9 you'll find - - - - - - - - ,4186
Their Sum is - - - - - - - - - - - 26,0001
and ſo much is the Area of 559 Inches long 26,0001
and 100 broad; but becauſe it is 300, ſet it 26,0001
down as in the Margin. 78,0003

2. Look 42 in the Top, and under it, and againſt 300, you'll find - - - - - - 5,8604

Againſt 200 you'll find - - - - - - - - 3,9069

Againſt 50 you'll find - - - - - - - - - ,9767

Againſt 9 you'll find - - - - - - - - - ,1758

Their Sum is - - - - - - - - - - - 10,9198 the Area of 559 long and 42 broad, to which add 78,0003 the Area of 559 long and 300 broad, and the Sum will be - - - - - - - - - 88,9201

Which is the Area of a Couch, whoſe Breadth is 342 Inches and Length 559; and the like may be done by any other which exceeds the Table.

To Gauge a Triangle by the Table.

RULE I.

Find Half the Perpendicular in the Top of the Table; then under that, and againſt the Baſe, you'll have the Area.

EXAMPLE II.

Let the Perpendicular of the Triangle propoſed be 86 Inches, and the Baſe 255, what's the Area?

Look in the Top of the Table for 43, and under that, and againſt 250, you'll find 5,0000

And againſt 5 you'll find - - - - - - 0,1000

Their Sum, *viz.* - - - - - - - - - - 5,1000 is the Area required.

I might here proceed, and ſhew how to find the Areas of all other right-lined Figures, and alſo the Contents of ſuch Tuns to which any right-lined Superficies may be a Baſe; but if what is already laid down in this Book be well underſtood, the Learner will be able to perform any ſuch Queſtion without farther Directions.

A practical Method of finding the Area of any Couch, without either Pen, Sliding Rule, or Table, as it was delivered to me by my ingenious Friend Mr Fitz-Lambe, *now Superviſor in* Worceſter *Collection.*

The Rules for Couch Gauges are theſe.

If the Length or Breadth be 215, or 2,15, the other is the Area.

If	430 or 43 64,5 or 645 860 107,5 129 150,5 172, 193,5	multiply by	2 3 4 5 6 7 8 9

If the Dimenſions be otherwiſe, it may be performed near the Truth by the Obſervations following.

If the Length and Breadth be near the ſame, take from one, and add the like Number to the other; ſo that you make one of them equal to one of the above Numbers.

If the Length be double (or near double) the Breadth, what you take from the Length muſt be but Half, or not quite Half, added to the Breadth: Or if you take from the Breadth, you muſt add double, or rather more than double, to the Length, and ſo in Proportion, and then proceed as above.

A TABLE

A
TABLE
TO
Gauge right-lined FIGURES,

When the Dimenſions are taken in Inches and decimal Parts, as in Ciſterns, *&c.*

	0	1	2	3	4	5
1	.000465	.000516	.000558	.000604	.000651	.000697
2	.000930	.000976	.001023	.001069	.001116	.001162
3	.001395	.001442	.001488	.001534	.001581	.001628
4	.001860	.001900	.001953	.002000	.002046	.002093
5	.002325	.002372	.002418	.002246	.002511	.002558
6	002790	.002837	.002883	.002930	.002976	.003023
7	.003256	.003302	.003344	.003395	.003442	.003488
8	.003721	.003767	.003819	.003860	.003907	.003953
9	.004186	.004232	.004279	.004325	.004372	.004418
10	.004651	.004697	.004744	.004790	.004837	.004884
11	.005116	.005163	.005209	.005256	.005022	.005349
12	.005581	.005628	.005674	.005721	.005767	.005814
13	.006046	.006093	.006139	.006180	.006232	.006279
14	.006511	.006558	.006694	.006651	.006697	.006744
15	.006977	.007023	.007239	.007116	.007163	.007209
16	.007442	.007488	.007535	.007581	.007628	.007674
17	.007907	.007953	.008000	.008046	.008093	.008139
18	.008372	.008418	.008465	.008511	.008558	.008604
19	.008837	.008883	.008930	.008976	.009023	.009065
20	.009302	.009348	.009395	.009441	.009438	.009534
21	.009767	.009813	.009860	.009906	.009953	.010000
22	.010232	.010279	.010325	.010372	.010418	.010465
23	.010697	.010744	.010790	.010837	.010883	.010837
24	.011168	.011209	.011255	.011302	.011348	.011395
25	.011628	.011674	.011720	.011767	.011813	.011860
26	.012093	.012139	.012186	.012232	.012279	.012325
27	.012558	.012604	.012651	.012697	.012744	.012790
28	.013023	.013069	.013116	.013162	.013209	.013255
29	.013488	.013534	.013581	.013627	.013675	.013729
30	.013953	.014000	.014046	.014093	.014139	.014186
31	.014418	.014465	.014511	.014558	.014604	.014651
32	.014883	.014930	.014976	.015023	.015069	.015116
33	.015349	.015395	.015441	.015488	.015535	.015581
34	.015813	.015860	.015907	.015953	.016000	.016046
35	.016279	.016325	.016372	.016418	.016465	.016511
36	.016744	.016790	.016837	.016883	.016930	.016976
37	.017209	.017255	.017302	.017348	.017395	.017442
38	.017614	.017720	.017767	.017813	.017860	.017907
39	.018139	.018186	.018232	.018279	.018325	.018372
40	.018604	.018651	.018693	.018744	.018790	.018837
41	.019067	.019116	.019162	.019209	.019255	.019302
42	.019534	.019581	.019627	.019674	.019720	.019767
43	.020002	.020046	.020093	.020139	.020186	.020232

6	7	8	9	A	B
.000744	.000790	.000837	.000884	43	.02
.001209	.001255	.001302	.001348	86	.04
.001674	.001721	.001767	.001814	129	.06
.002139	.002186	.002232	.002279	172	.08
.002604	.002651	.002697	.002744	215	.10
.003069	.003116	.003163	.003209	258	.12
.003535	.003581	.003628	.003674	301	.14
.004000	.004046	.004093	.004139	344	.16
.004465	.004511	.004558	.004604	387	.18
.004930	.004977	.005023	.005069	430	.20
.005395	.005442	.005488	.005535	473	.22
.005860	.005907	.005953	.006000	516	.24
.006325	.006372	.006418	.006465	559	.26
.006790	.006837	.006884	.006930	602	.28
.007256	.007302	.007348	.007395	645	.30
.007721	.007767	.007814	.007860	688	.32
.008186	.008232	.008279	.008325	731	.34
.008651	.008607	.008744	.008790	774	.36
.009116	.009162	.009209	.009255	817	.38
.009581	.009627	.009674	.009720	860	.40
.010046	.010093	.010139	.010186	903	.42
.010511	.010558	.010604	.010651	946	.44
.010976	.011023	.011069	.011116	989	.46
.011441	.011488	.011534	.011581	1032	.48
.011906	.011953	.012000	.012046	1075	.50
.012372	.012418	.012465	.012511	1118	.52
.012837	.012883	.012930	.012976	1161	.54
.013302	.013348	.013395	.013411	1204	.56
.013767	.013813	.013860	.013906	1247	.58
.014232	.014279	.013425	.014372	1290	.60
.014697	.014744	.014790	.014837	1337	.62
.015162	.015209	.015255	.015302	1376	.64
.015628	.015674	.015721	.015767	1419	.66
.016033	.016139	.016186	.016232	1462	.68
.016558	.016604	.016651	.016697	1505	.70
.017023	.017069	.017116	.017162	1548	.72
.017488	.017534	.017581	.017627	1591	.74
.017953	.018000	.018046	.018093	1634	.76
.018418	.018465	.018511	.018558	1677	.78
.018883	.018930	.018976	.019023	1720	.80
.019349	.019395	.019442	.019488	1763	.82
.019814	.019860	.019907	.019952	1806	.84
.020279	.020325	.020372	.020418	1840	.86

The Uſe of the preceding Table for Ciſtern Gauges, &c.

CASE I.

If the Length or Breadth of a rectangular Ciſtern, *&c.* be any Number in the Column under A, multiply the other by the Decimal anſwering thereto under B, and the Product will be the Area at one Inch deep; which multiplied by the whole Depth, produceth the whole Content in Malt Buſhels and decimal Parts.

EXAMPLE I.

Let a Ciſtern be propoſed, whoſe Length is 257 Inches, and Breadth 172; and the Area at one Inch deep, be required.

Firſt look under A for either of the two Numbers, *viz.* 257 or 172, and there you'll find 172; and againſt it under B, ſtands ,08; by which you are to multiply 257, and the Product will be 20,56, which is the Area required, *i. e.* 20 Buſhels and $\frac{56}{100}$.

EXAMPLE II.

Given the Length of a Ciſtern or Couch 989 Inches, and Breadth 771, to find the Area.

Look under A, and there you'll find 989; againſt which under B, you'll find ,46 for a Multiplier; by which multiply 771, and the Product will be 354,66, the Area required.

CASE II.

If neither the Length or Breadth can be found under A, you may take the next Number leſs under either of them, and note what Decimal ſtands againſt it under B; then take the Difference of the Number propoſed, and that next leſs which you find under A, and enter the firſt Column of the Table, and againſt that (and under the Tenths, if any be) you'll find another decimal Number, which added to your before-noted Decimal which you found under B, will give a Multiplier to be uſed as before.

EXAMPLE.

Let the Length be 1158,5, and Breadth 980,8, and the Area be required.

Firſt I look under A, and find not juſt 980,8, but the next to it leſs is 946, againſt which ſtands ,44 under B, which I note; then I take 946 out of 980,8, and the Remains will be 34,8; look 34 in the firſt Column, and againſt it under ,8 you'll find ,0161861; which add to the Decimal before found, *viz.* ,44, and the Sum will be ,456186; by which multiply 1158,5, and the Product will be 528,491, &c. the Area required, and ſo of any other: And tho' I have uſed 6 decimal Places here, yet four will be ſufficient in moſt Caſes. And thus having ſhewn the Uſe of this little, yet moſt extenſive Table, I ſhall next endeavour to ſhew any young Officer, how, when he has many Gauges to caſt up by the Sliding Rule, he may do them with that Inſtrument at one Set without finding the Area, or a Mean firſt, as is common.

The Way is this,

Take the Sliding Rule in your Left-Hand, and turn the Side marked with A. B. num. *Seg. ly.* towards you; this done, with your Right-Hand draw out the Sliding-Piece C, and place the Rabbit of the ſame which is next the Line of Numbers on the Corner of the Sliding Rule, which is at the Line of *Seg. ly.* ſo as that the 1 at the Beginning of the Line of Numbers on the Sliding-Piece noted with B, may be againſt 10 on the Line of Numbers on the Sliding-Piece C, or that the End of the Line of Numbers on the Sliding-Piece C, may ſtand againſt the Beginning of the Line of Numbers on the Sliding-Piece B. When the Piece is ſet as it ought to be, it will be perpendicular to the Side A. B. num. *Seg. ly.* and you may keep it in that Poſition with the Thumb of your Left-Hand; and if you hold the Rule ſo, as 'tis now ſuppoſed to be placed, the Part of the Line of Inches which is on the Inſide of the Sliding-Piece C, will be towards you, and lowermoſt; and the Areas thereto belonging, uppermoſt. When the Sliding-Piece C is placed on the Corner of the Rule at the Line of *Seg. ly.* as above directed, ſlip it along with your Right-Hand, till 2150, in the Line of Numbers on the ſame, ſtands exactly on the Line marked with 100 on the Line of

Seg. ly. and there keep it with the Thumb of your Left-Hand placed on the Inſide thereof: And as that Piece is now ſet, you may, at one Set of the Piece B, anſwer any ſuch Queſtion as is ſet below.

Let a Couch be propoſed, whoſe Length is 89 Inches, Breadth 64, and Depth 22, and it's Content be required.

The Rule being ſet as above directed, move with your Right-Hand the Sliding-Piece B, till 22 (the Depth propoſed) on the Line of Numbers there, comes againſt 64 on the Line of Numbers on the Piece C, (which with Uſe you will do very exact) then againſt 89 on the Line A, you'll find 58,28 on the Line B; and ſuch is the Content of that Couch.

EXAMPLE II.

What's the Content of a Ciſtern whoſe Length is 89,5 Inches, Breadth 64,2, and Depth 46,5.

The Sliding-Piece C remaining in the ſame Poſture as above, bring 46,5 in the Line of Numbers on the Piece B, to 64,2 on the Line of Numbers on the Piece C; then againſt 89,5 on the Line A, you'll find 124,27 on B, and ſo much the Ciſtern will contain. And here you are to remember always to ſet the Depth on the Line of Numbers on the Piece B, to either the Length or the Breadth in the Line of Numbers on the Piece C; then againſt the Length or Breadth on the Line A, you'll have the Content required on B: But there may be a Line of Numbers ſo contrived, inſtead of the Line of *Seg. ly.* as to work with thoſe on the Piece B, and anſwer all Queſtions of this Kind very nicely; which I hope will be taken Notice of by ſome ingenious Soul, whoſe Buſineſs it more immediately belongs to. And now having brought to an End what I did at firſt deſign, and made every Thing (that I thought convenient to handle) as plain as poſſible; I hope, I ſhall (by the Acceptance of this) be encouraged to appear again in Publick with ſome Curioſities in the noble Art, which I do deſignedly at preſent conceal.

A. N.

AN APPENDIX.

THE Preceding Work being chiefly intended for the Benefit of young Officers in the Exciſe, or others who endeavour to get their Bread that Way, was the Reaſon that ſo little is ſaid about Meaſuring of Boards, Timber, Stone, Wainſcotting, Glazing, *&c.* but, for the ſake of the ſeveral Artificers employed in Building, it was thought convenient to add what follows.

Board Meaſure.

There is a Board whoſe Breadth is 16 Inches, I demand how many Inches in Length muſt be taken to make one Foot ſquare.

1. By the *Pen.*

Divide 144 (the Number of ſquare Inches in a ſquare Foot) by any given Breadth, and the Quotient will be the Length required, and in this Caſe it will be 9 Inches.

2. By the *Sliding Rule.*

Set 16 upon B, to 12 upon A; then againſt 12 upon B, you'll have 9 upon A.

3. By *Gunter's Line.*

Extend your Compaſſes from 16 to 12, and the ſame Extent turned the ſame Way from 12, will reach to 9, as before; and ſo of any other Breadth.

Given the Breadth of a Board in Inches and Length in Feet, to find the Content in Feet.

1. By the *Pen*.

Multiply the Length of the Board in Feet, by the Breadth in Inches, and divide the Product by 12, the Quotient will be the Content of the Board in ſquare Feet.

EXAMPLE.

Given the Breadth of a Board 14 Inches, and Length 22 Feet, what's it's Content, *Facit*. $25\frac{2}{3} = 25$: 8. (Feet Inches)

2. By the *Sliding Rule*.

Set 12 upon B, to 14 upon A; then againſt 22 upon B, you'll have $25\frac{2}{3}$, or 25 : 8. (Feet Inches)

3. By *Gunter*'s *Line*.

Extend your Compaſſes from 12 to 14, and that Extent turned the ſame Way from 22, will reach to $25\frac{2}{3} = 25$: 8, (Feet Inch.) the Content as before.

N. B. That upon one Side of the Two-Foot-Rule you have a Line of Board-Meaſure, and another for Timber-Meaſure: That for Board-Meaſure has a little Table at the left End of it, ſet on thus.

1	2	3	4	5	6	7, &c. to about 36
12	6	4	3	2	2	
0	0	0	0	4	0	

The Uſe of this Line is to know how much in Length of any Board, whoſe Breadth is 36 Inches or leſs, will go to make one Foot ſquare. Thus, let the Breadth of a Board be one Inch, then 12 Feet in Length muſt be taken to make one Foot Square. If the Breadth is 2 Inches, then you muſt take 6 Feet; if 5 Inches broad, then 2 Feet and 4 Inches; if 6 broad, then 2 Feet But if the Breadth ſhould be 9 Inches, then look along the Line towards the Right-Hand for 9, and againſt that on the oppoſite Side of the Rule you'll have 16 Inches for the Length required. If the given Breadth had been 18 Inches, look for 18 in the ſame Line, and againſt that on the other Side you'll find 8 Inches, and ſo many muſt be taken of the Length of that Board to make one Foot ſquare.

In Practice you need only find the given Breadth. Suppoſe 10 Inches upon the Line of Board-Meaſure, then all the Diſtance between that, and that End of the Rule which is to the Right-Hand, is the Length of a Foot of that Board; and ſo many times as that Diſtance is found in the Length of the Board, ſo many ſquare Feet does the ſame contain. Now if a Board thus meaſured, or otherwiſe as before, ſhould be the uppermoſt Board of a Stock, you muſt multiply it's Content by the Number of Boards in the Stock, and the Product will be the Content of them all.

Sawyer's Work.

Theſe allow 120 Feet to the Hundred, for which they have about 2 Shillings, or 2 Shillings and 6 Pence. So if you'd find the Content of a Stock of Boards in ſuch Meaſure, and having found the Content of one Board by any of the Ways above-mentioned, you muſt then ſet 120 upon B, to the Number of Kerfs or Cuts (which are ever leſs by one than the Number of Boards in the Stock) upon A; then againſt the Content of one Board upon B, you'll have the Number of Sawyer's Hundreds upon A (if there is a Hundred in the Stock); the decimal Parts (if any) may be reduced to Feet, by ſetting 100 upon B, to 120 upon A; then againſt the decimal Parts upon B, you'll have the odd Feet upon A; or for every Tenth reckon 12 Feet, and every Hundredth reckon 1,2 Feet. According to this, if a Stock contained 24 Boards, and the Content of one of them be 30 Feet, you'll find the Sawing to be 500, and 90 Feet over.

By the *Pen*.

facit. *h.* *f.*
Say, as 120 : 23 : : 30 : 5,75 : 5 : 90
23
h. *f.* *h.*
120) 690 (5 : 90 = $5\frac{1}{4}$
600
90

By the *Sliding Rule*.

Set 120 upon B, to 23 upon A; then againſt 30 upon B, you'll find 5,75 upon A; that is, five Hundred, and three Quarters of a Hundred.

Square Timber.

There is a ſquare Piece of Timber, whoſe Side is 16 Inches, I demand how many Inches of the Length thereof muſt be taken to make one Foot ſolid.

By the *Pen*.

Divide 1728 (the Inches in a ſolid Foot) by the Square of the Side, and the Quotient will be the Anſwer: So if the Side of the Square be 16 Inches, then 6,75 Inches muſt be taken to make one Foot ſolid. If the Side be 9 Inches, then you muſt take 21,33 Inches, *&c.*

2. By the *Sliding Rule.*

Set the given Side 16 upon D, to 12 upon C; then againſt 12 on D, you'll have 6,75.

3. By *Gunter's Line.*

Extend your Compaſſes from the given Side 16 Inches to 12, and the ſame Extent turned twice the ſame Way from 12, will reach to 6,75, as before.

PROB. II.

Given the Side of a ſquare Piece of Timber 14 Inches, and Length 24 Feet, to find it's ſolid Content.

1. By the *Pen.*

Say as 12 is to the Side of the Square 14; ſo is the Length 24 Feet, to 28 a fourth Number. Again, ſay as 12 is to 14; ſo is 28, the fourth Number, to 32,66, the Content required.

2. By the *Sliding Rule.*

Set 12 upon D, to 24 the Length upon C; then againſt the Side of the Square 14 Inches upon D, you'll find 32,66 Feet upon C, for the Content, as before.

3. By the *Two-Foot-Rule*, or *Gunter's Line.*

Extend your Compaſſes from 12 to the Side of the Square 14, and that Extent will reach from the Length to 28, and from 28 to 32,66.

N. B. That the ſame Way that you turn your Compaſſes from 12 to the Side of the Square, the ſame Way you muſt turn them twice from the Length to the Content, whether it is towards the Right-Hand, or to the Left.

Unequal-ſided Timber.

There is an unequal-ſided Piece of Timber, whoſe Length is 28 Feet, it's Breadth 16 Inches, and Depth 10 Inches.

PROB. I.

I demand how many Inches in Length of the ſaid Piece muſt be taken to make one ſolid Foot.

1. By the *Pen.*

Divide 1728 by the Product of the Breadth 16, into the Depth 10, and the Quotient would be 10,8 Inches for the Anſwer.

2. By the *Sliding Rule.*

Find a mean Proportional between 16 Inches and 10 Inches, according to *Prob.* I. p. 60, and that will be 12,64. Then ſet the Mean 12,64 upon D, to 12 upon C; and againſt 12 upon D, you'll find 10,8 upon C, for the Anſwer.

3. By *Gunter's Line.*

Extend your Compaſſes from 12, to the Breadth 16; the ſame Extent will reach from the Depth 10 (turned the ſame Way) to 13,33, a fourth Number. Then as this fourth Number is to 12, ſo is 12 to 10,8, the Anſwer, as above.

PROB. II.

To find the ſolid Content of the ſaid Piece, you may either find a Mean between 16 *and* 10 *by the Pen, as at* Prob. I. pag. 20, *or by the Sliding Rule, as at* Prob. I. pag. 60; *which being* 12,64, *you may, by this and the Length* 28 *Feet, find the Content to be* 31,06. *According to any of the three Ways given at* Prob. II. *of Square Timber.*

The common Method taken to perform this, is to add the Breadth and Depth together; then they call Half that Sum, which in this Caſe is 13, the Side of the Square; by which, and the Length 28 Feet, you'll find the Content to be 32,85 Feet; which is near two Feet more than it ought to be, but Cuſtom will have it ſo.

Round Timber.

Note, That you may call that a Timber-Tree, the Fourth Part of whoſe Girth at Top is 6 Inches; if it is leſs, it is not reckoned Timber: And that when you take the Girth of a tapering Tree, within 2 or 3 Feet of the Ground, add 6 to the Fourth Part of that Girth; then Half that Sum will be the Fourth Part of the Girth at the Middle thereof.

PROB. I.

Given the Circumference in the Middle of a round Tree 60 *Inches, to find how much in Length will make one Foot ſolid.*

1. By the *Pen.*

Say as the Girth 60, is to 42,54 (a Point); ſo is 12 to 8,51, a fourth Number. Again, as 60 is to 42,54, ſo is 8,51 to 6,03 Inches, the Anſwer. According to the Square equal. But if you'd have it according to the Square inſcribed; then ſay, As the Girth 60, is to 53,25 (a Point); ſo is 12 to 10,65, a fourth Number. Again, as 60 is to 53,25, ſo is 10,65 to 9,45, the Anſwer.

2. By the *Sliding Rule.*

Set the Circumference 60 upon D, to 12 upon C; then againſt 42,54 upon D, you have 6,03 on C, according to the Square equal. But, to have the Anſwer according to the Square inſcribed, you muſt ſet the Circumference 60 upon D, to 12 upon C; then againſt 53,25 upon D, you have 9,45, as above.

3. By *Gunter's Line.*

Extend your Compaſſes from the Circumference 60 to 42,54, and that Extent turned twice the ſame Way from 12, will reach to 6,03; or extend from 60 to 53,25; the ſame Extent turned twice the ſame Way from 12, will reach to 9,45, as before.

PROB.

PROB. II.

Given the Circumference of a round Tree taken in the Middle (the Bark being off there) 60 *Inches, and Length* 32 *Feet, to find it's Content.*

1. By the *Pen.*

Say as 42,54, is to the Circumference 60; ſo is the Length 32 Feet to 45,13, a fourth Number. Again, ſay as 42,54 is to 60; ſo is 45,13 to 63,65, the Content of the Tree in ſolid Feet, according to the Square equal: But, to find it according to the Square inſcribed, ſay, as 53,25, is to 60; ſo is the Length 32 Feet to 36,05, a fourth Number. Again, as 53,25 is to 60; ſo is 36,05 to 40,62, the Content.

Here we find, that the whole Content of the Tree was - - - - - - - - - - - }	63,65
And the Content, according to the Square inſcribed, is - - - - - - - - - - - }	40,62
Their Difference is the Content of the four Slobs ſawn off }	23,03

2. By the *Sliding Rule.*

Set 42,54 upon D, to 32 the Length upon C; then againſt 60, the Circumference upon D, you'll find 63,65, the Content according to the Square equal. Or ſet 53,25 upon D, to 32 upon C; then againſt the Circumference 60 upon D, you have 40,62, the Content according to the Square inſcribed upon C.

3. By *Gunter's Line.*

Extend your Compaſſes from 42,54, to the Circumference 60; then the ſame Extent turned twice the ſame Way from 32, will reach to 63,65, the Content according to the Square equal. Or extend your Compaſſes from 53,25 to 60, and that Extent turned twice the ſame Way from 32, will reach to 40,62, the Content according to the Square inſcribed as before.

The Way uſed by Carpenters is to take the fourth Part of the Girth for the Side of the Square of the Piece, and then find the Content as Square Timber. So if they were to give the Content of the ſaid Piece, whoſe Circumference is 60 Inches, and Length 32 Feet, their Side of the Square would be 15 Inches, by which, and the Length, the Content would be 50 ſolid Feet, and leſs than the Truth by 13,65 Feet; however, as they both buy and ſell according to this Way of Meaſuring, it is what muſt be ſubmitted to, though not true; but having found the Content of a Piece of Timber in this Manner, you may thence find the true Content; this falſe Content (or any other thus meaſured) being to the true as 11 to 14. So if you ſet 11 upon B, to 14 upon A; then againſt 50 upon B, you'll find 63,6 upon A.

STONE.

Stone is meaſured by the Foot ſolid, the moſt expeditious Way of doing which, when there are many and well ſcubbled at the Quarry as they ought to be, is to lay a String from any one Corner round to it's oppoſite Corner, and that doubled, and meaſured in Feet, or Feet and Inches, muſt be ſet down as the Fourth Part of the whole Girth; and ſo do by every Stone in the Parcel, putting all the Quarter-

Girths under one another; then add them all together, and divide the Sum by the Number of the Stones in the Parcel, and the Quotient will be the Side of a Square common to them all. Having done this, you muſt have a Line 10, or rather 20, Feet long; and with that take the Length of all the Stones, as if they were laid End to End in a Right-Line, and when you have meaſured the whole Length of your Line, then make a Score to ſignify one Line; when it is up again, make another, *&c.* until you have meaſured the whole Parcel; then count your Scores, for ſo many as there are you muſt reckon ſo many Times 10 or 20 Feet, to which add the odd Feet and Inches (if any). And having thus obtained the whole Length and Side of the Square common to all, you may find the whole Content as you'd do a ſquare Piece of Timber of the ſame Dimenſions, by ſetting 12 upon D, to the Length upon C; then againſt the Side of the Square upon D, you'll have the Number of ſolid Feet upon C; which being divided by 20, will reduce them into Tuns, *&c.*

N. B. That there is a Line of Timber-Meaſure upon the ſame Side of the Rule that the Line of Board-Meaſure before deſcribed is on, and appears thus.

1	2	3	4	5	6	7	8		9, &c. to about 24 Inch. 1	6
144	36	16	9	5	4	2	2			
0	0	0	0	9	0	11	3			

The Uſe of this Line is to find how many Inches in Length of a Tree or Piece of Timber muſt be taken to make one ſolid Foot, having the Side of the Square or Fourth Part of the Girth given. Thus,

If the Side be 1 Inch, then look in the Table, and under 1 you'll find 144 Feet for the Length of a Foot; if 2 Inches, then 36 Feet; if it is 7 Inches, then 2 Feet 11 Inches of the Length is to be taken, *&c.*

But if the Side of the Square, or Fourth Part of the Girth of a Piece of Timber, be above what you have in the uppermoſt Part of the Table, as 9, 10, 11 Inches, *&c.* Seek it in the Line, and all the Part of the Rule that is contained between that and the End of the Rule that is towards the Right-Hand, is what muſt be taken for the Length of a Foot; and ſo often as that is contained in a Piece of Timber, ſo many ſolid Feet are in that Piece.

PLANIMETRY.

Or the Art of meaſuring Superficies, which are ſuch Figures whoſe external Parts are only conſidered without minding Depth or Thickneſs, as in Painting, Plaiſtering, &c.

To keep the Book from ſwelling too faſt, I muſt refer the Reader to the Figures and their Definitions, as they are laid down in the Gauging Part, and, ſuppoſing the Reader acquainted with Decimals, ſhall work the Examples that Way.

To find the Area of a Square.

RULE.

Square the Side, or multiply it by itſelf, and the Product is the Area, or ſuperficial Content.

EXAMPLE.

Let A B C D, Page 87, be a Square, whoſe Side, ſuppoſe B C, is 16 Feet 9 Inches, I demand it's Content.

```
               16,75
               16,75
             -------
                8375
              11725
             10050
             1675            Feet Inch. Pts.
       ----------------
Facit  280,5625 = 280 : 6 : 9
             12
       ----------
         6,7500
             12
       ----------
         9,0000
```

By the *Sliding Rule.*

Set 1 upon B, to 16,75 upon A; then againſt 16,75 upon B, you'll find 280,56 upon A, the Anſwer in ſquare Feet. If you would have the Area in ſquare Yards: Then ſet 9 upon B, to 16,75 upon A; and againſt 16,75 upon B, you'll have 31,17 upon A, for the Anſwer; or divide 280,56 by 9, and the Quotient will be the ſame.

To find the Area of a Parallelogram.

RULE.

Multiply the Length by the Breadth, and the Product is the Area.

EXAMPLE.

Let ABCD, Page 89, be a Parallelogram, whoſe Length AB is 36 Feet 6 Inches, and Breadth BD 24 Feet 3 Inches, I demand it's Content in ſquare Feet, *&c.*

24,25

24,25
36,5
12125
14550
7275
Feet Inch. Pts.
Facit 885,125 = 885 : 1 : 6

If the Anſwer is required in ſquare Yards, it is thus:

Feet Inch. Pts. Yards Feet Inch. Pts.
9) 885 : 1 : 6 (98 : 3 : 1 : 6

By the *Sliding Rule.*

Set 9 upon B, to 24,25 upon A; then againſt 36,5 upon B, you'll find 98,34 Yards.

To find the Area of a Rhombus.

RULE.

Multiply any Side, as *a b* by D F, the neareſt Diſtance between that and it's oppoſite Side BF, and the Product is the Area.

EXAMPLE.

Let *a b* F B be a Rhombus, whoſe Side *a b* is 18 Feet 10 Inches, and neareſt Diſtance to it's oppoſite Side D F 16 Feet 4 Inches, What's it's Area? (See Fig. Page 91)

18,83
16,33
5649
5649
11298
1883
Feet Inch. Pts.
307,4939 = 307 : 5 : 10

By

By *Gunter*'s *Line*.

Extend your Compaſſes from 1 to 16,33, and the ſame Extent will reach from 18,83 to 307,49 ſquare Feet.

To find the Area of a Triangle.

RULE.

Multiply the Baſe by Half the Perpendicular, and the Product is the Area.

EXAMPLE.

Let ACE, Page 93, be a Triangle, whoſe Baſe AE is 57 Feet 2 Inches, and Perpendicular CF 36 Feet 6 Inches, given to find the Area.

```
    AE  =   57,16
  ½ CF  =   18,25
          ---------
            28580
           11432
          45728
          5716
          ---------    Feet  Inch.  Yards  Feet  Inch.
*Facit*   1043,1700 =  1043  :  2  =  115  :  8  :  2
```

By the *Sliding Rule*.

Set 9 upon B, to 18,25 upon A; then againſt 57,16 upon B, you'll find 115,9 Yards.

By *Gunter*'s *Line*.

Extend your Compaſſes from 9 to 18,25, and that Extent will reach from 57,16 to 115,9, as above.

To find the Area of a Trapezium.

RULE.

Having divided the Trapezium into two Triangles, as in the Figure at Page 95, add the two Perpendiculars AR and FC together, and multiply that Sum by Half the common Baſe DB, and the Product is the ſuperficial Content.

EXAMPLE.

Let ABCD be a Trapezium; let the common Baſe BD be 72 Feet 8 Inches, the Perpendicular AR = 58 Feet 5 Inches, and Perpendicular FC = 36 Feet 7 Inches, given to find it's Area or ſuperficial Content.

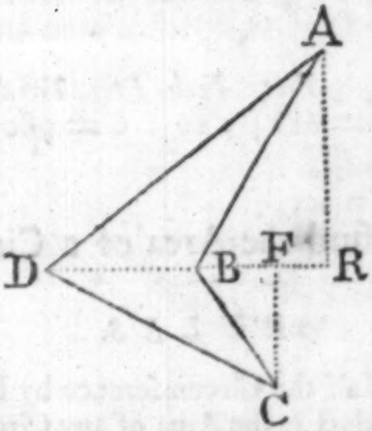
N. B. That if you multiply Half the Sum of the Perpendiculars by the whole Baſe, it will be the ſame, as in the next Example: In ſuch a Caſe, I always take Half that, that will be divided by 2 without a Remainder; or multiply the Whole, and take Half the Product for the Area.

AR = 58,41
FC = 36,58
Sum is 94,99
½ DB = 36,33
28497
28497
56994
28497

Anſwer, 3450,9867 = 3450 : 11 : 10 (*Feet* : *Inch.* : *Pts.*)

Every Trapezium conſiſts of four unequal Sides, according to the Definition given at Page 95; therefore the Figure following, *viz.* DABC is a Trapezium, whoſe common Baſe is DB = 22 Feet 3 Inches, Perpendicular AR = 27 Feet 9 Inches, and Perpendicular CF = 15 Feet 1 Inch; the Area of which is found at one Operation, according to the Rule given for the other.

AR = 27,75
CF = 15,09
Sum is 42,84
½ Sum is 21,42
Baſe 22,25
10710
4284
4284
4284
Facit 476,5950 = 476 : 7 : 1 (*Feet Inch. Pt.*)



To find the Area of a Hexagon.

RULE.

All regular Polygons (*i. e.* ſuch whoſe Sides are equal) may be meaſured by one General Rule, *viz.* multiply one Side by the Number of Sides, and that Product by Half the neareſt Diſtance of any Side from the Center, ſo the laſt Product is the Content.

EXAMPLE.

Let ABCDEF (Fig. at Page 97) be a Hexagon, whoſe Side ſuppoſe ED is 58 Feet 3 Inches, and neareſt Diſtance OQ = 50 Feet 6 Inches, What's the Area or Content thereof in ſquare Feet or Yards?

ED = 58,25
6
349,50
25,25
17475
6990
17475
6990

	Feet	*Inch.*	*Pts.*		*Yards*	*Feet*	*Inch.*	*Pts.*
8824,8750 =	8824 :	10 :	6	=	980 :	4 :	10 :	6

To find the Area of a Circle.

RULES.

1. Multiply Half the Circumference by Half the Diameter, and the Product is the Area of any Circle.
2. As 14 is to 11, ſo is the Square of the Diameter to the Area of the Circle.
3. Multiply the Square of the Diameter (taken in any Denomination) by ,785398, and the Product will be the Area.
4. Or, As 452 is to 355, ſo is the Square of the Diameter to the Area of a Circle.

EXAMPLES.

Let A B C D be a Circle, whoſe Diameter A B is 48,2 Feet, What's it's Area (See Fig. Page 99)?

Firſt Way, the Circumference of this Circle is (See Page 47).

151,42
Half the Circumference is 75,71
Half the Diameter is 24,1
7571
30284
15142
Facit 1824,611 *Square Feet.*

Second Way, As 14 : 11 : : 48,2 × 48,2 = 2323,24 : 1825,4 *Anſwer.*

Third Way, Multiply the Square of 48,2 = 2323,24 by ,785398, and the Product is 1824,668, the Area.

Fourth Way, As 452, : 355, : : 2323,24
355,
1161620
1161620
696972
Anſwer
452,) ~~824750~~,~~20~~(1824,668
~~3721120~~8(4
~~11101~~8(6
~~2333~~(2

Of all theſe four Ways the ſecond is moſtly uſed, becauſe the two firſt Numbers are ſmall; but the Area found by them being further from the Truth than either of the other, though ſufficient in common Practice, and in ſmall Circles; yet, when more Exactneſs is required, it will be beſt to uſe the fourth, or either of the other Ways.

By

By the *Sliding Rule.*

Firſt make a Point at ,7853 upon C, then ſet 1 upon D to the ſaid Point upon C; and againſt 48,2 upon D is 1824,668, the Area required upon C.

To find the Area of a Sector of a Circle.

RULE.

Multiply the Radius or Semidiameter AB or AC, by Half the Length of the Arch of the Section, and the Product is the Area.

EXAMPLE.

Let AB*q*C be a Sector of a Circle, (See Fig. at Page 102) and let the Radius AB = AC be 28 Feet 5 Inches, and BC = 20 Feet 6 Inches, What's the Area thereof in ſquare Feet and ſquare Yards?

AB = 28,41
Half BC = B*q* is 10,25

14205
5682
2841

Feet In. Pts. Yds. Feet In. Pts.
Facit 291,2025 = 291 : 2 : 5 = 32 : 3 : 2 : 5

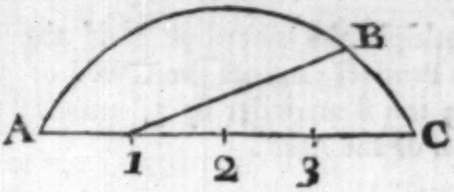
PROB. I.

To find the Length of an Arch of a Circle Geometrically.

Let ABC be an Arch-Line given, whoſe Length is required.

1. Draw the Line A C, which you muſt always divide into four equal Parts, and ſet one of them from C to B.

2. Draw a Line from B to the firſt Diviſion, ſo have you B 1; and that Line is Half the Arch-Line A B C, whoſe Double ſhall be the whole Arch-Line, as required.

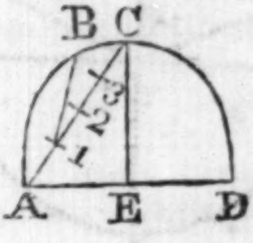


PROB. II.

To find the Length of an Arch-Line greater than a Semicircle.

1. Draw AD, and upon the Middle thereof at E, erect the Perpendicular EC, and draw the Line AC, which divide into four equal Parts.

2. Take one of thoſe Parts and ſet it from C to B, and draw the Line B 1, which Line is Half the Arch AC; conſequently four times B 1 is equal to the Arch-Line ABCD.



PROB. III.

To find the Length of the Arch of a Circle Arithmetically.

RULE.

Always multiply the Chord of Half the Segment by 8, and from the Product ſubtract the Chord of the whole Segment; divide the Remainder by 3, and the Quotient will be the Length of the Arch.

EXAMPLE.

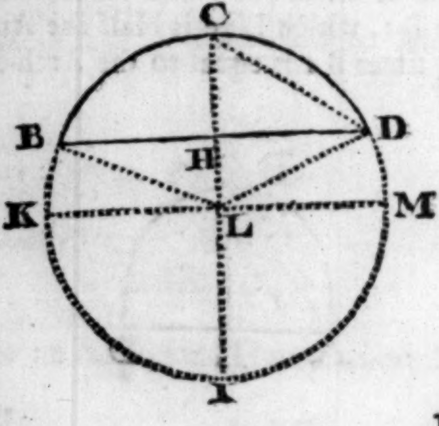
Let the verſed Sine CH = 18, and Chord BD = 48, be given to find the Length of the Arch-Line B C D.

1. By Caſe the firſt, Page 23, find C D = 30, the Chord of Half the given Arch, which being multiplied by 8 produces - - - - - - - - - - - - - - 240

2. The Chord of the whole Segment is 48 *Subſt.*

Remainder is - - - - - - - - 192

One Third Part of which is the Length of the Arch BCD = 64.



PROB.

PROB. IV.

To find the Area of the Segment BCD.

1. Having by the laſt Problem found the Length of the Arch-Line BCD to be 64, then,

2. Find HI thus, the Square of HD=24 is 576, which being divided by CH=18, you'll have 32 in the Quotient, which is the Length of HI, to which add CH=18, and the Sum is 50=CI, the Diameter of the Circle, the Half of which is 25 for the Length of LC or LD.

3. Now by Help of the Arch-Line BCD=64 before found, and the Radius LD=25, you may find the Area of the Sector LBCD=800.

4. From the Radius LC=25, take the verſed Sine CH=18, and there will remain LH=7. So now you have LH and BD=48, as given in the laſt Problem, to find the Content of the Triangle LBD, which according to the Rule for meaſuring a Triangle is 168.

5. From the Area of the Sector LBCD= 800
Take the Area of the Triangle LBD= 168
The Remainder is the Area of the Segment BCDH= 632
So for any other.

Another Way to find the Area of a Segment of a Circle very near the Truth.

RULE.

To thrice the Square of the Difference between the verſed Sine and Radius, add four Times their Rectangle or Product, ſubtract the Sum from 7 Times the Square of the Radius, the Remainder is a Dividend. Then to thrice the ſaid Difference add 4,5 Times the Radius for a Diviſor, and the Rectangle of the Quotient into Half the Chord will be the Area of the Segment.

EXAMPLE.

Let the verſed Sine be 18 = CH, and Chord 48 = DB be given to find the Area of the Segment BCDH. (See the laſt Figure.)

By the Work of the laſt Problem, the Radius LC was found to be 25, and the Difference between that and the verſed Sine CH was 7 = LH. Then according to the Rule,

Seven Times the Square of 25, is - - - - 4375,
Thrice the Square of 7, is - - 147, } Sum 847, *Subſt.*
Four Times 7, multiplied by 25, is 700, }
Remains a Dividend - - - - - - - - - 3538,
Thrice the ſaid Difference, *viz.* 7, is 21,
And 4,5 Times 25 is - - - - - 112,5
The Sum is a Diviſor - - - - - 133,5

Then 133,5) 3538,0000 (26,426 Quotient.
,868000(0
6763(9
39(2
(1

The Quotient 26,426 multiplied by 24 (half the Chord) is 634,224, the Area required.

To find the Area of an Oval.

RULE.

Say as 14 is to 11, or rather as 452 is to 355, ſo is the Rectangle or Product of the Tranſverſe into the Conjugate Diameter to the Area or Content.

EXAMPLE.

Let the Tranſverſe Diameter AB be 32 Feet 3 Inches, and Conjugate Diameter CD = 26 Feet 6 Inches. (See Fig. Page 103) I demand it's Content.

Feet.

$$
\begin{array}{r}
\text{Feet.} \qquad\qquad\qquad \\
\text{As } 452 : 355 :: 32,25 \times 26,5 = 854,625 \\
355. \\
\hline
4273125 \\
4273125 \\
2563875 \\
\hline
452)\ \cancel{3}\cancel{0}\cancel{3}\cancel{3}\cancel{9}\cancel{1},\cancel{8}\cancel{7}5\ (671,221 \\
\cancel{3}\cancel{2}\cancel{1}\cancel{5}\cancel{9}43 \\
\cancel{0}\cancel{5}\cancel{9}\cancel{9}4 \\
\cancel{0}00
\end{array}
$$

Anſwer 671,221 ſquare Feet, or 74 Yards, 5 Feet, 2 Inches, and 7 Parts.

Or if you multiply the Rectangle of the two Diameters, *viz.* 854,625 by ,7854 (a conſtant Decimal), the Product will be 671,222, the Area differing very little from that above.

By the *Sliding Rule.*

Set 1,273 (the Square of the Diameter of a Circle, whoſe Area is 1,) upon B, to 32,25 upon A; then againſt 26,5 upon B, you'll have 671,22 upon A.

By *Gunter*'s *Line.*

Extend your Compaſſes from 1,273 to 26,5, and the ſame Extent will reach from 32,25 to 671,22, as before.

To find the Content of any irregular Figure muſt needs be very eaſy to thoſe who will take Notice of what is ſaid about them, at Pages 113, 114, 115, and 116, and underſtand what has been done in this Part. But as Painters have often Occaſion to meaſure not only the Surface of diverſe Sorts of Bodies, but their Solidity alſo, we will, for the Sake of ſuch, add Rules for both.

STERE-

STEREOMETRY.

Or the Art of meaſuring Solids, or ſuch Bodies as conſiſt of Length, Breadth, and Thickneſs, as Timber, Stone, &c. which may happen to be in the Form of any of the following Figures.

To find the Content of a Cube.

RULE.

Cube it's Side, and you have the ſolid Content.

EXAMPLE.

Let the Side AB, equal to AF, be 7,5 Feet; I demand it's Content (See Fig. Page 119).

```
        7,5 Feet,
        7,5
       ----
        375
       525
      -----
      56,25
        7,5
      -----
      28125
     39375
     -------
Facit 421,875 Solid Feet.
```

By the *Sliding Rule.*

Set 1 upon D, to 7,5 upon C; then againſt 7,5 upon D, you'll have 421,875 upon C.

By

By *Gunter*'s *Line*.

Extend your Compaſſes from 1 to 7,5, the ſame Extent turned twice from 7,5, will reach to 421,875, as before.

For the ſuperficial Content, you muſt find the Area of one Side, and multiply that by the Number of Sides.

Side - - - - - - -	7,5
	7,5
	375
	525
Area of one Side - -	56,25
	6
Superficial Content - -	337,50

To find the Content of a Parallelopipedon.

RULE.

Multiply the Length by the Breadth, and the Product by the Depth, the laſt Product is the ſolid Content.

EXAMPLE.

Let the Length AB be 32,7 Feet, Breadth AE = GF = 2,8, and Depth EF = AG = 3,5, be given to find it's ſolid Content (See Fig. Page 121).

32,7

$$\begin{array}{r} 32{,}7 \\ 2{,}8 \\ \hline 2616 \\ 654 \\ \hline 91{,}56 \\ 3{,}5 \\ \hline 45780 \\ 27468 \\ \hline \end{array}$$

Anſwer 320,460 *Solid Feet.*

By the *Sliding Rule.*

Set 1 upon B, to 2,8 upon A; then againſt 32,7 upon B, you'll have 91,56. Again, Set 1 upon B, to 3,5 upon A; then againſt 91,56 upon B, you'll have 320,46 upon A.

By *Gunter*'s *Line.*

Extend your Compaſſes from 1 to 2,8, and the ſame Extent will reach from 3,5 to 9,8. Again, Extend your Compaſſes from 1 to 9,8, and the ſame Extent will reach from 32,7 to 320,46, the ſolid Content, as above.

The ſuperficial Content will be the Area of the four Sides, and two Ends added together thus:

	AB	32,7	AB = EC	32,7	AE	2,8
	AE	2,8	EF =	3,5	AG	3,5
		2616		1635		140
		654		981		84
Area of the upper and lower Sides.		91,56 91,56		114,45 114,45		9,80 9,80
		183,12		228,9		19,6

By

By the preceding Work it appears, that the Area of the upper and lower Sides, is - - - -	183,12
Area of the other two Sides is - - - - - - -	228,9
And that of the two Ends - - - - - - - - -	19,6
The Sum is the ſuperficial Content of all - -	431,62

To find the Content of a Priſm.

RULE.

Multiply the Baſe of the Triangle at the End by Half the Perpendicular, and that Product by the Length will be the ſolid Content.

EXAMPLE.

Let AC be 5,6 Feet, BD=3,6 Feet, and AG=DF 26,6. I demand the ſolid Content. (See Fig. Page 124.)

AC = 5,6
Half BD = 1,8
448
56
10,08
Length DF 26,6
6048
6048
2016
Facit 268,128

Thoſe that can multiply by the *Sliding Rule*, or *Gunter*'s *Line*, need no further Inſtructions here.

For the ſuperficial Content, you muſt find the Area of the three Parallelograms, and two Triangles, their Sum is the Anſwer.

To find the Content of a Cylinder.

RULE.

Multiply the Square of the Diameter by the Length; then ſay, as 14 is to 11, or rather as 452 is to 355, ſo is that Product to the ſolid Content.

EXAMPLE.

Let the Diameter AB be 4,2 Feet, and Length AC = 24,4 Feet, I demand the ſolid Content. (See Fig. Page 126.)

AB = 4,2
4,2
84
168
17,64
AC = 24,4
7056
7056
3528
As 452, : 355, : : 430,416
355,
2152080
2152080
1291248
Feet.
452,) ~~152797,6~~80 (338,047 *Anſwer.*
~~171316~~0(6
~~3625~~(4(3
0

The ſuperficial Content is double the Area of one of the Circles at the End, and alſo the Area of a Parallelogram, one of whoſe Sides is the Circumference of the Cylinder, and the other the Length thereof.

To find the Content of a Cone.

RULE.

Multiply the Square of the Diameter by the Height; then ſay, as 42 is to 11, ſo is that Product to the ſolid Content.

EXAMPLE.

Let the Diameter be DC=4,8 Feet, and Height AB=42 Feet. What's the ſolid Content? (See Fig. Page 128.)

$$\begin{array}{rrl}
DC = & 4,8 & \\
 & 4,8 & \\ \hline
 & 384 & \\
 & 192 & \\ \hline
 & 23,04 & \\
AB = & 42, & \\ \hline
 & 4608 & \\
 & 9216 & \\ \hline
 & 967,68 & \\
 & 11, & \textit{Feet.} \\ \hline
42,) & \cancel{1}\cancel{0}\cancel{6}\cancel{4}\cancel{4},\cancel{4}8 & (253,44 \ \textit{Facit.} \\
 & \cancel{2}\cancel{2}\cancel{4}8\cancel{6}(0 & \\
 & \cancel{1}\cancel{1}\cancel{1}(0 &
\end{array}$$

For the ſuperficial Content, you muſt multiply Half the Circumference at the Baſe by the ſlant Side, and to this Product add the Area of the Circle at the Baſe.

To find the Content of a Square Pyramid.

RULE.

Multiply the Square of the Side by one Third Part of the Height, and the Product is the ſolid Content.

EXAMPLE.

Let the Side CE=AE be 7,2 Feet, and Height 34,5 Feet, What's the ſolid Content? (See Fig. Page 130.)

AE = 7,2
7,2
144
504
51,84
One Third of the Height is 11,5
25920
5184
5184
Facit 596,160 *Solid Feet.*

N. B. That whatever Figure the Baſe of a Pyramid may be, whether a Circle, Square, Triangle, Pentagon, Heptagon, or, *&c.* you need only find the Area thereof, and multiply that by one Third Part of the Height, and you'll have the ſolid Content.

To find the Content of a parabolick Conoid.

RULE.

Multiply the Square of the Diameter by the Height; then ſay, as 28 is to 11, ſo is that Product to the ſolid Content.

EXAMPLE.

Let the Diameter BC be 8,6 Feet, and Height AO = 24,4 Feet, What's the ſolid Content? (See Fig. Page 132.)

$$\begin{array}{r}
8{,}6 \\
8{,}6 \\
\hline
516 \\
688 \\
\hline
73{,}96 \\
24{,}4 \\
\hline
29584 \\
29584 \\
14792 \\
\hline
1804{,}624
\end{array}$$

Then 28, : 11, : : 1804,624

$$\begin{array}{r}
11 \\
\hline
28,)\ \cancel{1}\cancel{9}8\cancel{5}\cancel{0},8\cancel{6}\cancel{4}\,(708{,}959 \\
\cancel{2}\cancel{2}\cancel{6}\cancel{6}\cancel{6}(2 \\
\cancel{1}2(1
\end{array}$$

Anſwer.

To fine the Content of a Hyperbolick Conoid.

RULE.

Multiply the Square of the Diameter by the Height; then ſay, as 168 is to 55, ſo is that Product to the ſolid Content.

EXAMPLE.

Let the Diameter BC be 4,3 Feet, and Height AO = 22,6 Feet, What's the ſolid Content? (See Fig. Page 134.)

4,3
4,3
129
172
18,49
22,6
11094
3698
3698
Then 168 : 55 : : 417,874
55
2089370
2089370
168,) ~~2~~~~2~~~~9~~8~~3~~,~~0~~~~7~~~~0~~ (136,803 *Facit.*
~~6~~~~1~~~~4~~~~5~~~~6~~(6(6
~~1~~~~1~~~~3~~~~0~~(1
~~1~~~~0~~

To find the Content of a Spheroid.

RULE.

Multiply the Square of the Conjugate Diameter by the Tranſverſe Diameter; then ſay, as 21 is to 11, ſo is that Product to the ſolid Content.

EXAMPLE.

Let the Conjugate Diameter be AB = 6,2 Feet, and Tranſverſe Diameter CD = 9,7 Feet, What's the ſolid Content thereof? (See Fig. Page 136.)

AB

$$\begin{array}{rr}
AB = & 6{,}2 \\
 & 6{,}2 \\ \hline
 & 124 \\
 & 372 \\ \hline
 & 38{,}44 \\
CD = & 9{,}7 \\ \hline
 & 26908 \\
 & 34596 \\ \hline
\text{Then } 21, : 11, :: & 372{,}868 \\
 & 11, \quad \textit{Feet Solid.} \\ \hline
21,) & \cancel{4}\cancel{1}\cancel{0}\cancel{1},\cancel{5}\cancel{4}8 \ (195{,}311 \ \textit{Anſwer.} \\
 & \cancel{2}\cancel{0}\cancel{1}\cancel{6}23(7 \\
 & \cancel{1}\cancel{0}(1
\end{array}$$

To find the ſolid Content of a Sphere or Globe.

RULE.

Cube the Globe's Diameter; then ſay, as 21 is to 11, ſo is that Cube to the ſolid Content.

EXAMPLE.

Let the Diameter be AB or CD = 3 Feet, What's the ſolid Content thereof? (See Fig. Page 138.)

AB = 3, *Feet.*
3,
9
3
Then 21 : 11 :: 27,
11,
21) 297, (14,14 *Solid Feet,*
21
87
84
30
21
90
84
06

Spheres being to be painted more commonly than moſt of the ſolid Figures before-mentioned, the ſuperficial Content is found by multiplying the Circumference by the Diameter.

Thus the Circumference of the Globe above-mentioned is - - - - - - - - - - -	9,42
Then - - - - - - - - - - - - - - - - -	3
The ſuperficial Content is - - - - - - - - -	28,26

To find the Content of an Elliptick Cone.

RULE.

Multiply the Rectangle of the tranſverſe and conjugate

Diameters by the Height; then ſay, as 42 is to 11, ſo is that Product to the ſolid Content.

EXAMPLE.

Let the tranſverſe Diameter be BC=4,6 Feet, the conjugate Diameter EF 4,2 Feet, and Height AO = 22,4 What's the ſolid Content? (See Fig. Page 141.)

```
      BC =  4,6
      EF =  4,2
           -----
              92
            184
           -----
           19,32
      AO    22,4
           -----
            7728
          3864
         3864
         --------
         432,768
               11,
        ----------
  42) 4760,448 (113,344 = the ſolid Content.
      054486(0
      4444(0
```

For the ſuperficial Content you muſt multiply Half the Girth at the Baſe by the ſlant Height.

To find the Content of the Fruſtum of a Cone.

RULE.

Find the Area of a Circle at the Top, and of that at the Bottom, and alſo a Mean between theſe two Areas. Add all three together, and multiply the Sum by one Third Part of the Height, the Product will be the ſolid Content.

EXAMPLE.

Let the Top Diameter be AC = 5,6 Feet, Bottom Diameter DF = 6,8 Feet, and Height BE = 16,5 Feet; What's the ſolid Content? (See Fig. Page 143.)

The Area of the Top is - - - - - - - - -	24,64
Area of the Bottom is - - - - - - - - -	36,33
A Geometrical Mean is - - - - - - - - -	29,92
The Sum of theſe Three is - - - - - - -	90,89

	90,89
One Third of BE is	5,5
	45445
	45445
The ſolid Cont. is	499,895

The ſuperficial Content is found by multiplying Half the Sum of the Circumferences of the Top and Bottom by the Height, and to that Product add the Areas of the Top and Bottom: So will the Sum be the Anſwer.

To find the Content of the Fruſtum of a Parabolick Conoid.

RULE.

Add the Area of the Top to the Area of the Bottom, and multiply that Sum by Half the Height, ſo will the Product be the ſolid Content.

EX-

EXAMPLE.

Let the Top Diameter be AC=5,6 Feet, Bottom Diameter DF=6,8 Feet, and Height BE=16,5 Feet, What's the ſolid Content? (See Fig. Page 147.)

The Area of the Top is -	24,64
Area of the Bottom is -	36,33
Sum is - - - - - - -	60,97
Half the Heighth is - -	8,25
	30485
	12194
	48776
The ſolid Content is -	503,0025

The ſuperficial Content may be found near enough the Truth in Practice, by taking a mean Girth ſomewhere between the Top and Bottom, and to the Product of that into the Height, add the Areas of the Top and Bottom.

To find the Content of the Fruſtum of an Elliptick Cone.

RULE.

To the Area of the Top add the Area of the Bottom, and alſo a Mean between theſe two Areas, multiply the Sum by one Third Part of the Height, and the Product will be the ſolid Content.

EXAMPLE.

Let the tranſverſe Diameter at the Top AB be equal to 2,15 Feet, the conjugate Diameter CD = 1,2. The tranſverſe Diameter at the Bottom FE = 3,32, conjugate Diameter 1,6 = GH, and Height IK = 4,5 Feet, to find the ſolid Content. (See Fig. Page 153.)

The Area of the Top is - - - - - - - - -	2,02
Area of the Bottom is - - - - - - - - -	4,17
A Mean Proportional is - - - - - - - - -	2,90
Sum is - - - - - - - - - - - - - - -	9,09
One Third Part of the Heighth is - - - - -	1,5
	4545
	909
Product is the ſolid Content - - - - - - -	13,635

The ſuperficial Content may be found near enough in Practice, by multiplying Half the Sum of the Girths at the Top and Bottom by the Height.

To find the Content of the Fruſtum of a Globe.

RULE.

To thrice the Square of the Semidiameter of the Fruſtum's Baſe, add the Square of it's Height, and multiply the Sum by the ſaid Height of the Fruſtum. Then ſay, as 21 is to 11, ſo is that Product to the ſolid Content.

EXAMPLE.

Let AB = 22,8 Feet be the Diameter of the Fruſtum's Baſe, and CD = 34,2 Feet be it's Height. (See Fig. Page 158.)

Half AB = AC is - - - - - 11,4
11,4
456
1254
The Square of AC is - - - 129,96
3,
389,88
The Square of CD = 34,2 is 1169,64
Sum is - - - - - - - - - 1559,52
34,2
311904
623808
467856
53335,584
11
21) 586691,424 (27937,686
16976484(8
101111(1

Hence the ſolid Content is 27937,686 *Feet.*

To find the ſuperficial Content of the Fruſtum of a Sphere, ſay, as the Diameter of the Sphere is to the ſuperficial Content of the Sphere; ſo is the Height of any Fruſtum to it's curve Superſicies, to which add the Area of the Fruſtum's Baſe, and the Sum is the whole ſuperficial Content of the Fruſtum.

Having thus done with Superficial and Solid Meaſure, I can't but think that it will be acceptable to add a ſew Pages upon Surveying of Land.

Surveying *of* LAND.

THE moſt common and moſt eaſy Inſtrument for this Purpoſe is the plain Table, which is a Parallelogram about fourteen Inches and a Half long, and eleven broad, and ſo larger in Proportion as the Surveyor thinks moſt proper; upon which there is a graduated Frame to ſerve inſtead of a Semicircle, Theodolite or Circumferentor, and has alſo a Box and Needle ſcrewed to the Side thereof to take the Bearings of Places, or give Notice of any Error that may happen in the Courſe of a Survey.

This plain Table, ſo made up, is moved upon a three-legg'd Staff, with a Ball and Socket, and ſo, by Help of an Index with Sights, is fit to take Obſervations, either by Angles and Diſtances of Objects, and afterwards map from ſuch Obſervations: Or, having a Sheet of Paper faſtened thereon by the ſaid Frame, you may meaſure and map at the ſame Time, with as much Certainty (eſpecially in dry Weather) as by any Inſtrument whatever.

Beſides this, you muſt have a Scale with a Diagonal Line, a Line of Chords, and Lines of equal Parts of ſeveral Lengths, together with a Pair of Compaſſes and a Chain.

The beſt Chain for this Purpoſe is that they call *Gunter*'s *Chain*, being 22 Yards long, or 4 Perches, each 5,5 Yards, and contains 100 Links, each Link being 7,92 Inches long.

When you meaſure with this, you may either write down the Number of Chains, and on the Right-Hand thereof make a Comma or Point, and after that ſet down the odd Links, or for every Chain reckon 100, and add the odd Links to that. So if you was to ſet down 7 Chains and 32 Links, it may ſtand thus, 7,32 Chains, or 732 Links, and in caſting up the Acres it is always conſidered in this——laſt Form, for a Reaſon which will be given in it's proper Place.

To take the Plot of a Field at one Station in any Part thereof as A, *from whence you may ſee all the Angles or Corners thereof.*

1. Plant your plain Table (being covered with a Sheet of Paper) at A, from whence you may ſee all the Angles, having firſt ſtuck up Pieces of white Paper at each, the better to be ſeen.

2. Direct your Sights to every Angle, from a Point A, taken at Pleaſure on the plain Table, and having meaſured the Diſtance between the Table and each Angle in Chains and Links, take them in your Compaſſes from your Diagonal Scale, and ſet them reſpectively from A to B, from A to C, from A to D, *&c.* which being done, draw Lines from B to C, from C to D, from D to E, *&c.* to compleat the Figure BCDEFGH, which will be the true Shape of the Field; this being had, you may then divide it into ſuch Figures as may be moſt convenient, in order to know how many Acres the ſame contains, as you ſee done in the ſecond Figure.

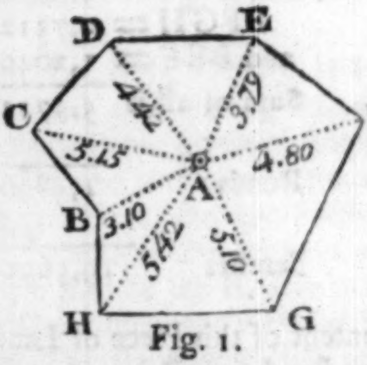


Fig. 1.

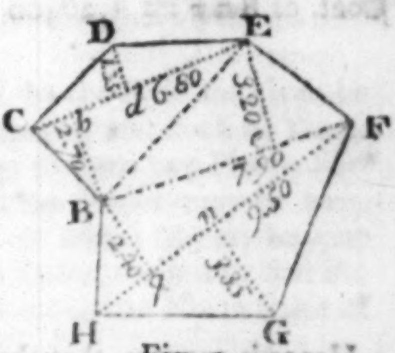


Fig. 2.

Figure the ſecond, being divided, is reduced to two Trapeziums BCDE and BFGH, and one Triangle BEF, the

Meaſure

Meaſure of whoſe Baſes and Perpendiculars, taken by the ſame Diagonal Scale that Fig. 1. was laid down from, are there ſet down, and the Content of each as follow.

$$CE = 6{,}80 \begin{cases} Dd = 1{,}35 \\ Bb = 2{,}70 \end{cases}$$

Sum is 4,05
Half CE is 3,40

1620
1215

Cont. of BCDE = 1,37700

$$HF = 9{,}50 \begin{cases} Bq = 2{,}40 \\ Gn = 3{,}35 \end{cases}$$

Sum is 5,75
Half HF is 4,75

2875
4025
2300

Cont. of BFGH = 2,73125

$$BF = 7{,}90 \begin{cases} Ee = 3{,}20 \\ \text{Half is } 1{,}60 \end{cases}$$

1,60

474
79

Cont. of BEF = 1,26400

Then BCDE = 1,37700
BFGH = 2,73125
and BEF = 1,26400

Sum of all is	5,37225
	4
Roods	1,48900
	40
Perches	19,56000

Hence it appears that the Content of this Piece of Land is five Acres, one Rood, and nine Perches or Poles.

N. B. That, from every one of the three Products firſt above found, I have cut off five Figures towards the Right-

Hand, and ſo a Stranger to this Art would be apt to think that I ſhould have cut off but four, there being but ſo many Decimal Places in both Factors: But let us conſider the firſt Product, *viz.* 137700 for Inſtance, which is produced from 4 Chains and 5 Links, or 405 Links, multiplied by 3 Chains and 40 Links, or 340 Links; therefore 137700 are ſo many ſquare Links for the Content of that Trapezium. But 160 ſquare Perches are one Statute Acre, then a Parallelogram, that is, 4 Perches equal to one Chain, or 100 Links broad, and 40 Perches equal to 10 Chains, or 1000 Links long, is a Statute Acre; but the Breadth 100 Links, multiplied by the Length 1000 Links, produces 100000 ſquare Links, and ſo many are in a Statute Acre. Therefore divide any Number of ſquare Links by 100000, and the Quotient is Acres; and that's done by pointing off a Figure for every Cypher in 100000, that is, five; according to which Rule 137700, will be 1,37700, as above; and ſo of any other.

To take the Plot of a Field at two Stations, when all the Angles thereof cannot be ſeen at one.

1. Let A B C D E F G H I K L be the Field that is to be meaſured, then having walked about it, and ſtuck up Pieces of white Paper at every Angle, go to ſome two Places, ſuppoſe M and N, from whence all the Angles may be ſeen, and call theſe your two Stations, of which M may be your firſt, where ſetting up your plain Table, turn it ſo that the North End of the Needle may point to the North Point of the Compaſſes that is in the Box.

2. Lay the fiducial Side of your Index over the firſt Station at M, direct it to K, L, A, B, C, and with one Point of your Compaſſes draw blank Lines towards each Angle, and having meaſured the Diſtance of each from your Station, ſet them down from your Diagonal Line as you ſee; and

draw a Line from K to L, from L to A, from A to B, and from B to C, ſo will you have the true Shape of one Part of the Field.

3. Direct your Sights to the ſecond Station at N, and towards that draw the Line M*q*; and having found the Diſtance between the two Stations to be, ſuppoſe ſix Chains and ſeventy Links, ſet that from M to N, ſo is N your ſecond Station upon the Table.

4. Remove it to N, and having laid the ſame Side of the Ruler or Index upon the Line M*q*, by which it was drawn, turn the Table about until you can ſee your firſt Station thro' the Sights; then obſerve the Needle, and if it hangs over the North Point as you ſet it at the firſt Station, then is your Table rightly ſet.

5. Being now at N, lay your Index to that Point, and direct it to D, E, F, G, H, I, and towards each of them draw Lines, as ND, NE, NF, *&c.* and from N ſet off the Chains and Links that anſwer to thoſe Diſtances reſpectively; which being done, draw a Line from D to E, from E to F, from F to G, from G to H, and from H to I: and thus you have obtained the true Shape of the whole as Fig. 1. The ſecond is the ſame Piece divided, in order to find the Content thereof.

Fig. 1.

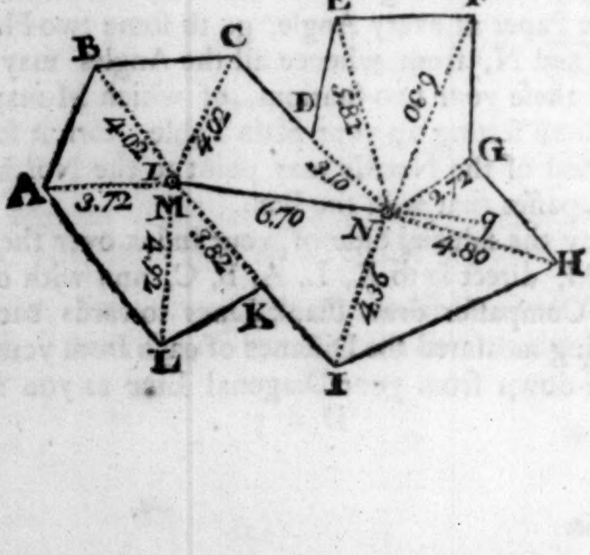
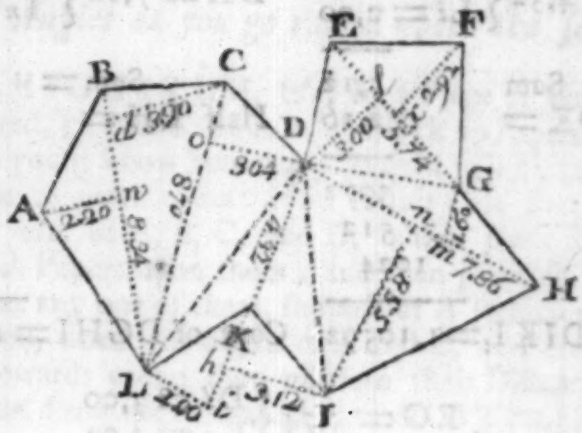


Fig. 2.



This Figure, being thus divided, is reduced to four Trapeziums, *viz.* DEFG, DGHI, DIKL, LABC, and one Triangle DCL. Whoſe Areas are found as in the former Example: Thus,

$$\text{BL} = 8{,}34 \left\{ \begin{array}{l} \text{CD} = 3{,}90 \\ \text{A}w = 2{,}20 \end{array} \right.$$

Sum 6,10

Half BL = 4,17

4270
610
2440

Cont. of LABC = 2,54370

CL = 8,70
Half D*o* = 1,52

1740
13050

1,32240

DK

$$DK = 4{,}32\left\{\begin{array}{l} Ib = 3{,}12 \\ Li = 2{,}00 \end{array}\right.$$

Sum 5,12

Half DK = 2,16

3072
512
1024

Cont. of DIKL = 1,10592

$$DH = 7{,}86\left\{\begin{array}{l} Gm = 1{,}60 \\ In = 5{,}58 \end{array}\right.$$

Sum = 7,18

Half DH = 3,93

2154
6462
2154

Cont. of DGHI = 2,82174

$$EG = 5{,}74\left\{\begin{array}{l} Dl = 3{,}00 \\ Fx = 2{,}92 \end{array}\right.$$

Sum 5,92

Half EG = 2,87

4144
4736
1184

$$\text{Content of}\left\{\begin{array}{l} DEFG = 1{,}69904 \\ DGHI = 2{,}82174 \\ DIKL = 1{,}10592 \\ LABC = 2{,}54370 \\ DCL = 0{,}93090 \end{array}\right.$$

Sum 9,10130
4

,40520
40

16,20800

The Content of the whole Piece is 9 Acres, 16 Perches.

To take the Plot of a Field by meaſuring to the ſeveral Angles as you go round about the ſame.

1. Let EFGHIKLM, *&c.* be a Piece of Ground to be meaſured, go round about it, and ſtick up Papers at each Angle, ſo you'll know how many Stations will be neceſſary, and where to place them: Now in this Caſe four will be ſufficient, *viz.* at A, B, C, and D, where place four long Sticks with Papers upon them; and then planting your Inſtrument at any one of them, ſuppoſe at A (which call your firſt Station), direct the Sights to Z and E, and draw Lines from A towards each; then meaſure their Diſtances with your Chain from the Station at A, *viz.* AZ = 2,50, and AE = 1,00, and ſet them off from your Scale to Z and E; which being done, draw the Line ZE for one Side of the Field.

2. Direct the Sights from the Point A, to the ſecond Station at B, *&c.* draw a Line as AB, then take up your Inſtrument from A, and ſet up the Station Stick in it's Place, and advance towards B; but having gone one Chain and 76 Links that Way, you come to the Corner at F; then taking 1,76 in your Compaſſes from the Diagonal Line, ſet that Extent from A to F, and draw the Line EF for another Side, and going ſtill forward, at 4 Chains and 16 Links, you'll come to *e*, oppoſite to the Angle G, to which meaſure; and finding it to be 1,38, take that in your Compaſſes, and ſet it from *e* to G, and draw GF for a third Side; then go on to the Corner at H, which is 8 Chains and 16 Links from the Station at A, take this in your Compaſſes and ſet it from A to H, and draw GH for a fourth Side; then go on in the ſame Direction to the ſecond Station at B, whoſe Diſtance from A you'll find to be 8 Chains and 86 Links, which being taken in your Compaſſes, ſet that Extent from A to B, and at B write a Figure of three, to ſignify the Place of your preſent Station.

3. Set up your Inſtrument at B, and laying the fiducial Side of the Ruler on which your Sights are placed upon the Line A B as you laid it when you drew that Line, turn the Table ſo that looking through the Sights you may ſee the Station Stick which you left at A; then ſcrew the Table in that Poſition, and laying the Index or Ruler upon the Station-Point B, direct the Sights to the ſeveral Corners at I, K, and L, and draw Lines from B towards each; then with your Chain meaſure the Diſtances from the Station-Point B, *viz.* BI=1,50, BK=2,12, and BL=1,92, take theſe reſpectively in your Compaſſes from the Diagonal Line, and ſet them from B to I, K, and L, and draw the Lines H I, I K, and K L.

4. The Table remaining fixed, direct the Sights to the third Station at C, and towards C draw the Line B C; then take up your Table, and leaving a Station Stick with a Paper upon it at B, proceed towards the third Station, and having meaſured 3 Chains and 20 Links that Way you come to the Angle at M; then take 3,20 in your Compaſſes, and lay that Extent upon the Line B C, from B to M, and draw L M. Advancing ſtill towards C, after having gone 5 Chains and 10 Links from B to *f*, you then come oppoſite to N, meaſure *f* N and it is 96 Links, which, being ſet from *f* to N, draw M N. Then proceed to the Angle at O, which you'll find to be 8 Chains from B; ſet theſe upon the Line B C, from B to O, and draw N O. From O go to the third Station at C, whoſe Diſtance from B is 10 Chains and 30 Links, which take from your Diagonal Line, and ſet it from B to C, and at that Point make the Figure 3 to denote the third Station.

5. Being now at your third Station C, plant the plain Table there, and laying the fiducial Edge of the Rule upon the Line B C, the ſame Way that you drew that Line turn the Table, ſo that looking through the Sights you may ſee the Paper that's upon the Station Stick at B; and then having ſcrew'd it faſt, lay the Ruler upon the Point C, and direct

the Sights to P, Q, R, and S, drawing Lines from C towards each, and then meaſure their Diſtances, *viz.* CP = 1,92, CQ = 70, CR = 1,92, and CS = 2,72, and ſet theſe from C to P, Q, R, and S, and draw the Lines OP, PQ, QR, and RS.

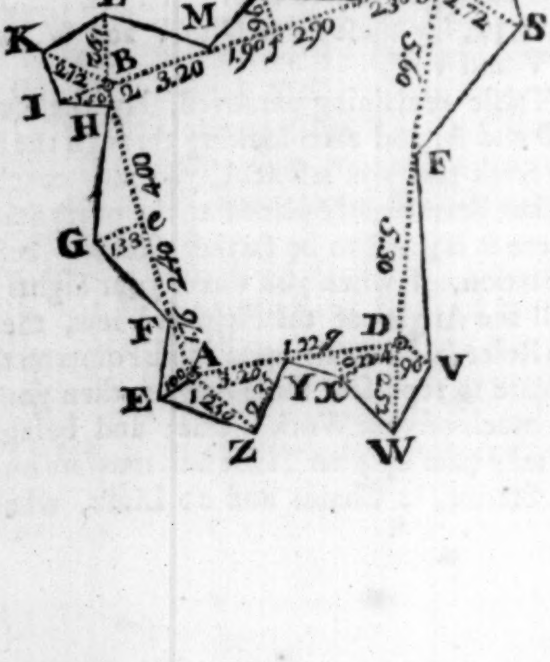
6. Your Table remaining fixed, direct the Sights to the fourth Station at D, and draw the Line CD; then take up the Table, and leaving a Station Stick with a Paper upon it in the Place, go towards the fourth Station 5 Chains and 60 Links, and you come to the Angle at F. Therefore take 5,60 in your Compaſſes, and lay that Extent from C to F, and having drawn SF, proceed on your Way to the fourth Station at D, whoſe Diſtance from C you'll find to be 10 Chains and 90 Links; take 10,90 in your Compaſſes, and lay that Extent from C to D, where make the Figure 4, to ſignify your fourth Station.

7. Having ſet up your Table at this fourth Station, lay the Ruler upon the Line CD, the ſame Way that you drew it before, and letting it lie ſo placed, turn the Table gently about until looking through the Sights you ſee the Station Stick that you left at C; then ſcrew it faſt, and directing the Sights from D to V and W, draw Lines from D towards thoſe Corners, and having meaſured their Diſtances, *viz.* DV = 90 and DW = 2,52, lay theſe from D to V and W, then draw the Lines FV and VW.

8. The Table remaining unmoved, lay the Ruler upon the Points D and A, and then looking through the Sights, if you ſee the Stick that you left at A, you may conclude that your Table has been rightly placed at the other Stations, as well as where it is; and to be farther ſatisfied before you leave that Station, if when you direct your Sights from D, to any or all the Angles of the Field in View, the fiducial Edge of the Ruler falls exactly upon thoſe Points on the Paper that were made to repreſent thoſe Angles, then you may be ſure that ſo much of your Work is true; and being thus ſatisfied, you may take up your Table and meaſure on towards A your firſt Station, 2 Chains and 20 Links, when you'll

come to *g*, oppoſite to the Corner at X; then take ,50 in your Compaſſes and lay that Extent from *g* to X, and draw WX; then go on until you come to Y, which you'll find to be 3 Chains and 42 Links from the Station at D; take 3,42 in your Compaſſes and lay it from D to Y, and draw the Line XY and ZY, ſo is your Field quite cloſed; but to know whether it is truly ſo, meaſure YZ with your Chain, and ſuppoſe you find it to be 2 Chains and 35 Links, keep this Meaſure in your Mind; then ſet one Foot of your Compaſſes in Y, and extend the other to the Angle at Z, apply this Extent to the ſame Line that you made Uſe of, and if it is 2,35 there, then you may leave the Field with Pleaſure, but it muſt be quite otherwiſe if this Part does not anſwer.

Now having (we ſuppoſe) got the Plot or true Shape of the Ground, you may reduce it into Trapeziums, Triangles, &c. in order to caſt up it's Content, as you ſee by the two preceding Examples.



To take the Plot of a Piece of Ground at two Stations within the ſame, from either of which all the Angles in the Piece may be ſeen by meaſuring only the Diſtance between thoſe two Stations.

Let the Piece C, D, E, F, G, H, *&c.* be to be meaſured in this Manner:

1. Having walk'd about it, and ſet up white Papers at each Angle, find out two ſuch Stations, ſuppoſe A and B, from either of which all the Corners or Angles may be ſeen, and there ſet up two Sticks with white Papers upon them, the better to be ſeen at a Diſtance.

2. Set up your plain Table at A, turning it ſo that it may ſtand lengthways towards C and I, that ſo you may have Room on the Paper that you have upon the Table to draw Lines towards G, H, I, K, which are longer towards thoſe Angles than the other.

3. Make choice of ſome Point, ſuppoſe 1, for your firſt Station upon your plain Table to repreſent A in the Field; then lay your Index with Sights upon the Point 1 or A, direct it towards the ſeveral Angles C, D, E, F, G, H, I, K, L, and M, and draw occult Lines towards each; this being done, direct the Sights to the Station at B, and towards that draw the Line A B, and ſet up a Station Stick with a Paper upon it at A; then take your Table to B, and as you go meaſure the Diſtance A B, which let be 8 Chains and 94 Links. Take 8,94 in your Compaſſes from the Diagonal Line, or any other Line of equal Parts, and lay that Extent from A to B, and at B ſet up your Table, and lay the fiducial Edge of the Ruler upon the Line A B, the ſame Way that you did when you drew that Line; then turn

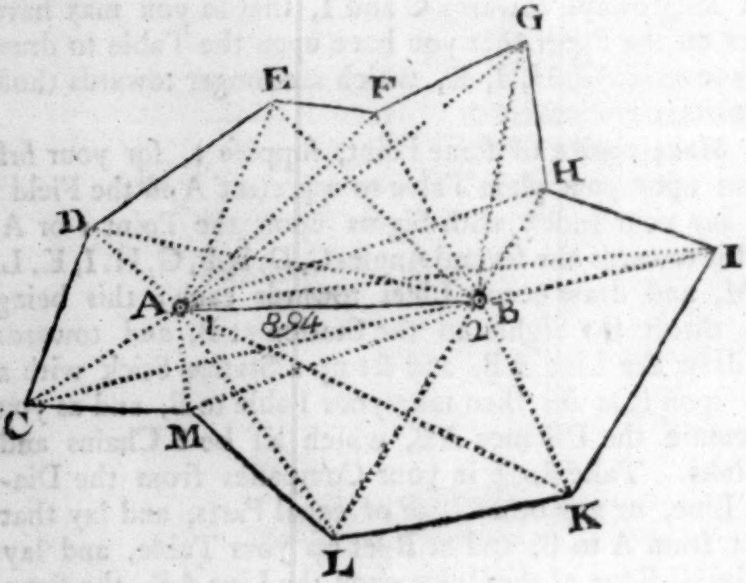
the

the Table ſo that you may ſee the Paper through the Sights that you left upon the Stick at the firſt Station A, and then ſcrew it faſt.

4. Lay the fiducial Edge of the Rule upon the Point B, and direct the Sights to the ſeveral Angles C, D, E, F, G, *&c.* as before, and draw Lines towards thoſe Angles until they interſect the Lines that you drew towards them from A; ſo the Line BC will interſect the Line AC in C, BD will interſect the Line AD in D, BE will interſect AE in E, *&c.*

5. From the ſeveral Points of Interſection as C, D, E, F, *&c.* draw the Lines CD, DE, EF, FG, GH, *&c.* quite round; ſo will you have the true Plot of the Field, which, by reducing it into proper Figures, you may caſt up as before.

N. B. That this Way ſhould be practiſed only upon even Ground.



When the laſt Example is thoroughly underſtood, you may very eaſily ſee the Manner of taking the Diſtance of Places, either from your firſt or ſecond Station, or from one another; for, purſuing the Method here delivered, you have the Diſtance of the Object F (for Inſtance), from G and AF, and AG, their Diſtance from the firſt Station; alſo BF, and BG, their Diſtance from the ſecond Station, in the ſame Denomination that you meaſured the Line AB by, whether Feet, Yards, Chains, *&c.*

A
TABLE
OF THE
AREAS of *CIRCLES*
AND
Contents *of* Cylinders

In Ale Gallons,

To all Diameters (in Inches and Tenths) from twelve Inches to one hundred fifty and ſix.

Areas of Circles and

Diam. in Inches.	DEPTH.			
	1	2	3	4
12.0	0.4011	0.80	1.20	1.60
.1	0.4078	0.81	1.22	1.63
.2	0.4146	0.83	1.24	1.65
.3	0.4214	0.84	1.26	1.69
.4	0.4282	0.86	1.28	1.71
.5	0.4352	0.87	1.30	1.74
.6	0.4422	0.88	1.33	1.77
.7	0.4492	0.90	1.35	1.80
.8	0.4563	0.91	1.37	1.82
.9	0.4635	0.93	1.39	1.85
13.0	0.4707	0.94	1.41	1.88
.1	0.4780	0.96	1.43	1.91
.2	0.4853	0.97	1.46	1.94
.3	0.4927	0.98	1.48	1.97
.4	0.5001	1.00	1.50	2.00
.5	0.5076	1.01	1.52	2.03
.6	0.5151	1.03	1.55	2.06
.7	0.5227	1.04	1.57	2.09
.8	0.5304	1.06	1.59	2.12
.9	0.5381	1.08	1.61	2.15
14.0	0.5459	1.09	1.64	2.18
.1	0.5537	1.11	1.66	2.21
.2	0.5616	1.12	1.68	2.24
.3	0.5695	1.14	1.71	2.28
.4	0.5775	1.15	1.73	2.31
.5	0.5856	1.17	1.76	2.34
.6	0.5937	1.19	1.78	2.37
.7	0.6018	1.20	1.80	2.40
.8	0.6100	1.22	1.83	2.44
.9	0.6183	1.24	1.85	2.47

Contents of Cylinders, *&c.*

DEPTH.				
5	6	7	8	9
2.01	2.41	2.81	3.21	3.61
2.04	2.44	2.85	3.26	3.67
2.07	2.49	2.90	3.31	3.73
2.11	2.53	2.95	3.37	3.79
2.14	2.57	3.00	3.43	3.86
2.18	2.61	3.05	3.48	3.92
2.21	2.65	3.10	3.54	3.98
2.24	2.69	3.14	3.59	4.04
2.28	2.73	3.19	3.65	4.10
2.32	2.78	3.24	3.71	4.17
2.35	2.82	3.30	3.77	4.24
2.39	2.87	3.35	3.82	4.30
2.43	2.91	3.39	3.88	4.36
2.46	2.95	3.44	3.94	4.43
2.59	3.00	3.50	4.00	4.50
2.53	3.04	3.55	4.06	4.56
2.58	3.09	3.61	4.12	4.63
2.61	3.13	3.65	4.18	4.70
2.65	3.18	3.71	4.24	4.77
2.69	3.23	3.77	4.30	4.84
2.73	3.27	3.82	4.36	4.91
2.76	3.32	3.87	4.42	4.98
2.81	3.37	3.93	4.49	5.05
2.84	3.41	3.98	4.55	5.12
2.88	3.46	4.04	4.62	5.19
2.93	3.51	4.10	4.68	5.26
2.96	3.56	4.15	4.74	5.34
3.01	3.61	4.21	4.81	5.41
3.05	3.66	4.27	4.88	5.49
3.09	3.71	4.33	4.94	5.56

Areas of Circles and

Diam. in Inches.	DEPTH.			
	1	2	3	4
15.0	0.6266	1.25	1.88	2.50
.1	0.6350	1.27	1.91	2.54
.2	0.6435	1.29	1.93	2.57
.3	0.6520	1.30	1.96	2.61
.4	0.6605	1.32	1.98	2.64
.5	0.6691	1.34	2.01	2.68
.6	0.6778	1.35	2.03	2.71
.7	0.6865	1.37	2.06	2.74
.8	0.6953	1.39	2.09	2.78
.9	0.7041	1.41	2.11	2.82
16.0	0.7130	1.43	2.14	2.85
.1	0.7219	1.44	2.16	2.89
.2	0.7309	1.46	2.19	2.92
.3	0.7400	1.48	2.22	2.96
.4	0.7491	1.50	2.25	3.00
.5	0.7582	1.52	2.27	3.03
.6	0.7654	1.53	2.30	3.07
.7	0.7767	1.55	2.33	3.10
.8	0.7861	1.57	2.36	3.14
.9	0.7954	1.59	2.39	3.18
17.0	0.8049	1.61	2.41	3.22
.1	0.8144	1.63	2.44	3.26
.2	0.8239	1.64	2.47	3.29
.3	0.8335	1.67	2.50	3.33
.4	0.8432	1.69	2.53	3.37
.5	0.8529	1.70	2.56	3.41
.6	0.8627	1.72	2.58	3.45
.7	0.8725	1.74	2.62	3.49
.8	0.8824	1.76	2.65	3.53
.9	0.8924	1.78	2.68	3.57

Contents of Cylinders, *&c.*

DEPTH.				
5	6	7	8	9
3.13	3.76	4.38	5.01	5.63
3.18	3.81	4.45	5.08	5.72
3.22	3.86	4.50	5.15	5.79
3.26	3.91	4.56	5.22	5.87
3.30	3.96	4.62	5.28	5.94
3.35	4.01	4.68	5.35	6.02
3.39	4.06	4.74	5.42	6.09
3.43	4.12	4.80	5.49	6.18
3.48	4.17	4.87	5.56	6.26
3.52	4.22	4.93	5.63	6.34
3.57	4.28	4.99	5.70	6.42
3.61	4.33	5.05	5.78	6.50
3.65	4.39	5.12	5.85	6.58
3.70	4.44	5.18	5.92	6.66
3.75	4.49	5.24	5.99	6.74
3.79	4.55	5.31	6.06	6.82
3.84	4.60	5.37	6.14	6.90
3.88	4.66	5.43	6.21	6.99
3.93	4.71	5.50	6.28	7.07
3.98	4.77	5.57	6.36	7.16
4.02	4.83	5.63	6.44	7.24
4.07	4.88	5.70	6.51	7.33
4.12	4.94	5.77	6.59	7.42
4.17	5.00	5.83	6.66	7.50
4.22	5.06	5.90	6.74	7.59
4.26	5.11	5.97	6.82	7.68
4.31	5.17	6.03	6.90	7.76
4.36	5.23	6.10	6.98	7.85
4.41	5.29	6.17	7.06	7.94
4.46	5.35	6.24	7.14	8.03

Areas of Circles and

Diam. in Inches.	DEPTH.			
	1	2	3	4
18.0	0.9024	1.80	2.71	3.61
.1	0.9124	1.82	2.74	3.65
.2	0.9225	1.84	2.77	3.69
.3	0.9327	1.87	2.80	3.73
.4	0.9429	1.88	2.83	3.77
.5	0.9532	1.91	2.86	3.81
.6	0.9635	1.93	2.89	3.85
.7	0.9739	1.95	2.92	3.90
.8	0.9843	1.97	2.95	3.94
.9	0.9948	1.99	2.98	3.98
19.0	1.0054	2.01	3.02	4.02
.1	1.0160	2.03	3.05	4.06
.2	1.0267	2.05	3.08	4.11
.3	1.0374	2.07	3.11	4.15
.4	1.0482	2.10	3.14	4.19
.5	1.0590	2.12	3.18	4.24
.6	1.0699	2.14	3.21	4.28
.7	1.0808	2.16	3.24	4.32
.8	1.0918	2.18	3.27	4.37
.9	1.1029	2.21	3.31	4.41
20.0	1.1140	2.23	3.34	4.46
.1	1.1252	2.25	3.38	4.50
.2	1.1364	2.27	3.41	4.55
.3	1.1477	2.29	3.44	4.59
.4	1.1590	2.32	3.48	4.64
.5	1.1704	2.34	3.51	4.68
.6	1.1819	2.36	3.54	4.73
.7	1.1934	2.39	3.58	4.77
.8	1.2049	2.41	3.61	4.82
.9	1.2165	2.43	3.65	4.86

Contents of Cylinders, &c.

DEPTH.				
5	6	7	8	9
4.51	5.41	6.31	7.22	8.12
4.56	5.47	6.38	7.30	8.21
4.61	5.53	6.45	7.38	8.30
4.66	5.59	6.53	7.46	8.39
4.71	5.66	6.60	7.54	8.49
4.77	5.72	6.67	7.63	8.58
4.82	5.78	6.74	7.71	8.67
4.87	5.85	6.82	7.79	8.77
4.92	5.90	6.89	7.87	8.86
4.97	5.97	6.96	7.95	8.95
5.03	6.03	7.04	8.04	9.05
5.08	6.10	7.11	8.13	9.14
5.13	6.16	7.18	8.21	9.23
5.19	6.22	7.26	8.30	9.34
5.24	6.29	7.34	8.38	9.43
5.30	6.35	7.41	8.47	9.53
5.35	6.42	7.49	8.56	9.63
5.40	6.49	7.57	8.65	9.73
5.46	6.55	7.64	8.74	9.83
5.51	6.62	7.72	8.82	9.93
5.57	6.68	7.80	8.91	10.03
5.63	6.75	7.88	9.00	10.13
5.68	6.82	7.95	9.09	10.23
5.74	6.88	8.03	9.18	10.33
5.80	6.95	8.11	9.27	10.43
5.85	7.02	8.19	9.36	10.53
5.91	7.09	8.27	9.46	10.64
5.97	7.16	8.35	9.54	10.74
6.02	7.23	8.43	9.64	10.84
6.08	7.30	8.51	9.73	10.94

Areas of Circles and

Diam. in Inches.	DEPTH.			
	1	2	3	4
21.0	1.2282	2.46	3.68	4.91
.1	1.2400	2.48	3.72	4.96
.2	1.2517	2.50	3.75	5.01
.3	1.2635	2.53	3.79	5.05
.4	1.2754	2.55	3.83	5.10
.5	1.2874	2.57	3.86	5.15
.6	1.2994	2.60	3.90	5.20
.7	1.3114	2.62	3.39	5.25
.8	1.3236	2.65	3.97	5.29
.9	1.3357	2.67	4.01	5.34
22.0	1.3480	2.70	4.04	5.39
.1	1.3602	2.72	4.08	5.44
.2	1.3726	2.75	4.12	5.49
.3	1.3850	2.77	4.16	5.54
.4	1.3974	2.79	4.19	5.59
.5	1.4099	2.82	4.23	5.64
.6	1.4225	2.84	4.27	5.69
.7	1.4351	2.87	4.31	5.74
.8	1.4478	2.90	4.34	5.79
.9	1.4605	2.92	4.38	5.84
23.0	1.4733	2.95	4.42	5.89
.1	1.4861	2.97	4.46	5.94
.2	1.4990	3.00	4.50	6.01
.3	1.5120	3.02	4.54	6.05
.4	1.5250	3.05	4.58	6.10
.5	1.5380	3.08	4.61	6.15
.6	1.5511	3.10	4.65	6.20
.7	1.5643	3.13	4.69	6.26
.8	1.5775	3.15	4.73	6.31
.9	1.5908	3.18	4.77	6.36

Contents of Cylinders, &c.

DEPTH.				
5	6	7	8	9
6.14	7.37	8.60	9.82	11.05
6.20	7.44	8.68	9.92	11.16
6.26	7.51	8.76	10.01	11.26
6.32	7.58	8.84	10.11	11.37
6.38	7.65	8.93	10.20	11.48
6.44	7.72	9.01	10.30	11.59
6.50	7.80	9.09	10.39	11.69
6.56	7.87	9.18	10.49	11.80
6.62	7.94	9.26	10.59	11.91
6.68	8.01	9.35	10.68	12.02
6.74	8.09	9.44	10.78	12.13
6.80	8.16	9.52	10.88	12.24
6.86	8.23	9.61	10.98	12.35
6.93	8.31	9.70	11.08	12.47
6.99	8.38	9.78	11.18	12.58
7.05	8.46	9.87	11.28	12.69
7.11	8.53	9.96	11.38	12.80
7.18	8.61	10.05	11.48	12.92
7.24	8.68	10.13	11.58	13.02
7.30	8.76	10.22	11.68	13.14
7.37	8.84	10.31	11.78	13.26
7.43	8.92	10.40	11.89	13.37
7.50	8.99	10.49	11.99	13.49
7.56	9.07	10.58	12.10	13.61
7.63	9.15	10.68	12.20	13.73
7.69	9.23	10.77	12.30	13.84
7.76	9.31	10.86	12.41	13.96
7.82	9.39	10.95	12.51	14.08
7.89	9.46	11.04	12.62	14.20
7.95	9.54	11.13	12.72	14.31

Areas of Circles and

Diam. in Inches.	DEPTH.			
	1	2	3	4
24.0	1.6042	3.21	4.81	6.42
.1	1.6176	3.23	4.85	6.47
.2	1.6310	3.26	4.89	6.52
.3	1.6445	3.29	4.93	6.58
.4	1.6581	3.32	4.97	6.63
.5	1.6717	3.34	5.01	6.69
.6	1.6854	3.37	5.06	6.74
.7	1.6991	3.40	5.10	6.80
.8	1.7129	3.43	5.14	6.85
.9	1.7267	3.45	5.18	6.91
25.0	1.7406	3.48	5.22	6.96
.1	1.7546	3.51	5.26	7.02
.2	1.7686	3.54	5.31	7.07
.3	1.7827	3.57	5.35	7.13
.4	1.7968	3.59	5.39	7.19
.5	1.8110	3.62	5.43	7.24
.6	1.8252	3.65	5.48	7.30
.7	1.8395	3.68	5.52	7.36
.8	1.8538	3.71	5.56	7.42
.9	1.8682	3.74	5.60	7.47
26.0	1.8827	3.77	5.65	7.53
.1	1.8972	3.79	5.69	7.59
.2	1.9117	3.82	5.73	7.65
.3	1.9264	3.85	5.78	7.71
.4	1.9411	3.88	5.82	7.76
.5	1.9558	3.91	5.87	7.82
.6	1.9706	3.94	5.91	7.88
.7	1.9854	3.97	5.96	7.94
.8	2.0003	4.00	6.00	8.00
.9	2.0153	4.03	6.05	8.06

Contents of Cylinders, *&c.*

DEPTH.				
5	6	7	8	9
8.02	9.62	11.23	12.83	14.44
8.09	9.70	11.32	12.93	14.55
8.16	9.79	11.42	13.05	14.68
8.22	9.86	11.51	13.15	14.80
8.29	9.95	11.61	13.26	14.92
8.36	10.03	11.70	13.37	15.04
8.43	10.11	11.80	13.48	15.17
8.50	10.19	11.89	13.59	15.29
8.56	10.28	11.99	13.70	15.42
8.63	10.36	12.08	13.81	15.54
8.70	10.44	12.18	13.92	15.67
8.77	10.53	12.28	14.03	15.79
8.84	10.61	12.38	14.15	15.91
8.91	10.70	12.47	14.26	16.04
8.98	10.78	12.57	14.37	16.17
9.06	10.87	12.68	14.49	16.30
9.13	10.95	12.78	14.60	16.43
9.20	11.04	12.88	14.71	16.55
9.27	11.12	12.98	14.83	16.69
9.34	11.21	13.08	14.94	16.81
9.41	11.29	13.18	15.06	16.94
9.49	11.38	13.28	15.18	17.07
9.56	11.47	13.38	15.29	17.20
9.63	11.56	13.48	15.41	17.34
9.70	11.65	13.59	15.53	17.47
9.78	11.73	13.69	15.65	17.60
9.85	11.82	13.79	15.76	17.74
9.93	11.91	13.90	15.88	17.87
10.00	12.00	14.00	16.00	18.00
10.08	12.09	14.11	16.12	18.14

Areas of Circles and

Diam. in Inches	DEPTH.			
	1	2	3	4
27.0	2.0303	4.06	6.09	8.12
.1	2.0454	4.09	6.14	8.18
.2	2.0605	4.12	6.18	8.24
.3	2.0757	4.15	6.23	8.30
.4	2.0909	4.18	6.27	8.36
.5	2.1062	4.21	6.32	8.42
.6	2.1215	4.24	6.36	8.48
.7	2.1369	4.27	6.41	8.55
.8	2.1524	4.30	6.46	8.61
.9	2.1679	4.33	6.50	8.67
28.0	2.1835	4.37	6.55	8.73
.1	2.1991	4.40	6.60	8.80
.2	2.2148	4.43	6.64	8.86
.3	2.2305	4.46	6.69	8.92
.4	2.2463	4.49	6.74	8.98
.5	2.2621	4.52	6.79	9.05
.6	2.2780	4.56	6.83	9.11
.7	2.2940	4.59	6.88	9.18
.8	2.3100	4.62	6.93	9.24
.9	2.3261	4.65	6.98	9.30
29.0	2.3422	4.68	7.03	9.37
.1	2.3584	4.72	7.07	9.43
.2	2.3746	4.75	7.12	9.50
.3	2.3910	4.78	7.17	9.56
.4	2.4073	4.81	7.22	9.63
.5	2.4237	4.85	7.27	9.69
.6	2.4401	4.88	7.32	9.76
.7	2.4567	4.91	7.37	9.83
.8	2.4732	4.94	7.42	9.89
.9	2.4899	4.98	7.47	9.96

Contents of Cylinders, *&c.*

DEPTH.				
5	6	7	8	9
10.15	12.18	14.21	16.24	18.27
10.23	12.27	14.32	16.36	18.41
10.30	12.36	14.42	16.48	18.54
10.38	12.45	14.53	16.61	18.68
10.45	12.55	14.64	16.73	18.82
10.53	12.64	14.74	16.85	18.95
10.61	12.73	14.85	16.97	19.09
10.68	12.82	14.96	17.10	19.23
10.76	12.91	15.06	17.22	19.37
10.84	13.01	15.18	17.34	19.51
10.92	13.10	15.28	17.46	19.65
11.00	13.19	15.39	17.59	19.79
11.08	13.29	15.50	17.71	19.93
11.15	13.38	15.61	17.84	20.07
11.23	13.48	15.72	17.97	20.22
11.31	13.57	15.83	18.10	20.36
11.39	13.67	15.95	18.22	20.50
11.47	13.76	16.06	18.35	20.65
11.55	13.86	16.17	18.48	20.79
11.63	13.96	16.28	18.61	20.93
11.71	14.05	16.39	18.74	21.08
11.79	14.15	16.51	18.86	21.22
11.87	14.25	16.62	18.99	21.37
11.96	14.35	16.74	19.13	21.52
12.04	14.44	16.85	19.26	21.66
12.12	14.54	16.96	19.39	21.81
12.20	14.64	17.08	19.52	21.96
12.28	14.74	17.19	19.65	22.10
12.37	14.84	17.31	19.78	22.26
12.45	14.94	17.43	19.92	22.41

Areas of Circles and

Diam. in Inches.	DEPTH.			
	1	2	3	4
30.0	2.5066	5.01	7.52	10.03
.1	2.5233	5.05	7.57	10.09
.2	2.5401	5.08	7.62	10.16
.3	2.5570	5.11	7.67	10.23
.4	2.5739	5.15	7.72	10.29
.5	2.5908	5.18	7.77	10.36
.6	2.6078	5.21	7.82	10.43
.7	2.6249	5.25	7.87	10.50
.8	2.6420	5.28	7.93	10.57
.9	2.6592	5.32	7.98	10.64
31.0	2.6764	5.35	8.03	10.71
.1	2.6938	5.39	8.08	10.78
.2	2.7111	5.42	8.13	10.84
.3	2.7285	5.46	8.19	10.91
.4	2.7460	5.49	8.24	10.98
.5	2.7635	5.53	8.29	11.05
.6	2.7811	5.56	8.34	11.12
.7	2.7987	5.60	8.40	11.19
.8	2.8163	5.63	8.45	11.27
.9	2.8341	5.67	8.50	11.34
32.0	2.8519	5.70	8.56	11.41
.1	2.8698	5.74	8.61	11.48
.2	2.8877	5.78	8.66	11.55
.3	2.9057	5.81	8.72	11.62
.4	2.9237	5.85	8.77	11.69
.5	2.9418	5.88	8.83	11.77
.6	2.9599	5.92	8.88	11.84
.7	2.9781	5.96	8.93	11.91
.8	2.9963	5.99	8.99	11.98
.9	3.0146	6.03	9.04	12.06

Contents of Cylinders, &c.

DEPTH.				
5	6	7	8	9
12.53	15.04	17.54	20.05	22.56
12.62	15.14	17.66	20.18	22.71
12.70	15.24	17.78	20.32	22.86
12.79	15.34	17.90	20.46	23.01
12.87	15.44	18.02	20.59	23.17
12.95	15.55	18.14	20.73	23.32
13.04	15.65	18.25	20.86	23.47
13.12	15.75	18.37	21.00	23.62
13.21	15.85	18.49	21.14	23.78
13.30	15.95	18.61	21.27	23.93
13.38	16.06	18.73	21.41	24.09
13.47	16.16	18.86	21.55	24.25
13.56	16.27	18.98	21.69	24.40
13.64	16.37	19.10	21.83	24.56
13.73	16.48	19.22	21.97	24.71
13.82	16.58	19.34	22.10	24.87
13.91	16.69	19.47	22.25	25.03
13.99	16.79	19.59	22.38	25.18
14.08	16.90	19.71	22.53	25.35
14.17	17.00	19.84	22.67	25.51
14.26	17.11	19.96	22.82	25.67
14.35	17.22	20.09	22.96	25.83
14.44	17.32	20.21	23.10	25.98
14.53	17.43	20.34	23.24	26.15
14.62	17.54	20.46	23.39	26.31
14.71	17.65	20.59	23.53	26.48
14.80	17.76	20.72	23.68	26.64
14.89	17.87	20.85	23.82	26.80
14.98	17.98	20.97	23.97	26.97
15.07	18.09	21.10	24.11	27.13

Areas of Circles and

Diam. in Inches.	DEPTH.			
	1	2	3	4
33.0	3.0330	6.07	9.10	12.13
.1	3.0514	6.10	9.15	12.21
.2	3.0698	6.14	9.21	12.28
.3	3.0884	6.18	9.26	12.35
.4	3.1069	6.21	9.32	12.43
.5	3.1256	6.25	9.38	12.50
.6	3.1443	6.29	9.43	12.58
.7	3.1630	6.33	9.49	12.65
.8	3.1818	6.36	9.55	12.73
.9	3.2007	6.40	9.60	12.80
34.0	3.2196	6.44	9.66	12.88
.1	3.2385	6.48	9.71	12.95
.2	3.2576	6.51	9.77	13.03
.3	3.2766	6.55	9.83	13.11
.4	3.2958	6.59	9.89	13.18
.5	3.3150	6.63	9.95	13.26
.6	3.3342	6.67	10.00	13.34
.7	3.3535	6.71	10.06	13.41
.8	3.3728	6.75	10.12	13.49
.9	3.3923	6.78	10.18	13.57
35.0	3.4117	6.82	10.24	13.65
.1	3.4312	6.86	10.29	13.73
.2	3.4508	6.90	10.35	13.80
.3	3.4705	6.94	10.41	13.88
.4	3.4902	6.98	10.47	13.96
.5	3.5099	7.02	10.53	14.04
.6	3.5297	7.06	10.59	14.12
.7	3.5496	7.10	10.65	14.20
.8	3.5695	7.14	10.71	14.28
.9	3.5894	7.18	10.77	14.36

Contents of Cylinders, *&c.*

DEPTH.				
5	6	7	8	9
15.17	18.20	21.23	24.26	27.30
15.26	18.31	21.36	24.41	27.46
15.35	18.42	21.49	24.56	27.63
15.44	18.53	21.62	24.71	27.79
15.53	18.64	21.75	24.85	27.96
15.63	18.75	21.88	25.00	28.13
15.72	18.86	22.01	25.15	28.30
15.82	18.98	22.14	25.30	28.47
15.91	19.09	22.27	25.45	28.63
16.00	19.20	22.40	25.60	28.80
16.10	19.32	22.54	25.75	28.97
16.19	19.43	22.67	25.90	29.14
16.29	19.54	22.80	26.06	29.32
16.38	19.66	22.93	26.21	29.49
16.48	19.77	23.07	26.36	29.66
16.58	19.89	23.21	26.52	29.84
16.67	20.00	23.34	26.67	30.01
16.77	20.12	23.47	26.82	30.18
16.86	20.23	23.61	26.98	30.35
16.96	20.35	23.75	27.14	30.53
17.06	20.47	23.88	27.29	30.70
17.16	20.59	24.01	27.45	30.88
17.25	20.70	24.16	27.61	31.06
17.35	20.82	24.29	27.76	31.24
17.45	20.94	24.43	27.92	31.41
17.55	21.06	24.57	28.08	31.59
17.65	21.18	24.71	28.24	31.76
17.75	21.30	24.85	28.39	31.94
17.85	21.42	24.99	28.55	32.13
17.95	21.53	25.12	28.71	32.30

Areas of Circles and

Diam. in Inches.	DEPTH.			
	1	2	3	4
36.0	3.6095	7.22	10.83	14.44
.1	3.6295	7.26	10.89	14.52
.2	3.6497	7.30	10.95	14.60
.3	3.6699	7.34	11.01	14.68
.4	3.6901	7.38	11.07	14.76
.5	3.7104	7.42	11.13	14.84
.6	3.7308	7.46	11.19	14.92
.7	3.7512	7.50	11.25	15.00
.8	3.7717	7.54	11.32	15.09
.9	3.7922	7.58	11.38	15.17
37.0	3.8128	7.63	11.44	15.25
.1	3.8334	7.67	11.50	15.33
.2	3.8541	7.71	11.56	15.42
.3	3.8749	7.75	11.62	15.50
.4	3.8957	7.79	11.69	15.58
.5	3.9165	7.83	11.75	15.67
.6	3.9374	7.87	11.81	15.75
.7	3.9584	7.92	11.88	15.83
.8	3.9794	7.96	11.94	15.92
.9	4.0005	8.00	12.00	16.00
38.0	4.0217	8.04	12.06	16.09
.1	4.0428	8.09	12.13	16.17
.2	4.0641	8.13	12.17	16.24
.3	4.0854	8.17	12.26	16.34
.4	4.1068	8.21	12.32	16.43
.5	4.1282	8.26	12.38	16.51
.6	4.1496	8.30	12.45	16.60
.7	4.1712	8.34	12.51	16.68
.8	4.1927	8.39	12.58	16.77
.9	4.2144	8.43	12.64	16.86

Contents of Cylinders, &c.

DEPTH				
5	6	7	8	9
18.05	21.66	25.27	28.87	32.48
18.15	21.78	25.41	29.03	32.66
18.25	21.90	25.55	29.19	32.84
18.35	22.02	25.69	29.36	33.03
18.45	22.14	25.83	29.52	33.21
18.55	22.26	25.97	29.68	33.39
18.65	22.39	26.11	29.85	33.58
18.76	22.51	26.26	30.01	33.76
18.86	22.63	26.40	30.17	33.94
18.96	22.75	26.55	30.34	34.13
19.07	22.88	26.69	30.51	34.32
19.17	23.00	26.83	30.67	34.50
19.27	23.12	26.98	30.83	34.69
19.37	23.25	27.12	31.00	34.87
19.48	23.37	27.27	31.17	35.06
19.58	23.50	27.41	31.33	35.25
19.69	23.62	27.56	31.50	35.43
19.79	23.75	27.71	31.66	35.62
19.90	23.87	27.86	31.83	35.81
20.00	24.00	28.00	32.00	36.00
20.11	24.13	28.15	32.17	36.19
20.21	24.26	28.30	32.34	36.39
20.30	24.36	28.43	32.49	36.56
20.43	24.51	28.60	32.68	36.77
20.54	24.64	28.75	32.85	36.96
20.64	24.77	28.90	33.02	37.15
20.75	24.90	29.05	33.19	37.34
20.86	25.03	29.20	33.37	37.54
20.96	25.15	29.35	33.54	37.73
21.07	25.29	29.50	33.71	37.93

Areas of Circles and

Diam. in Inches.	DEPTH.			
	1	2	3	4
39.0	4.2361	8.47	12.71	16.94
.1	4.2578	8.52	12.77	17.03
.2	4.2796	8.56	12.84	17.12
.3	4.3015	8.60	12.90	17.20
.4	4.3234	8.65	12.97	17.29
.5	4.3454	8.69	13.04	17.38
.6	4.3674	8.73	13.10	17.47
.7	4.3895	8.78	13.17	17.56
.8	4.4117	8.82	13.24	17.65
.9	4.4338	8.87	13.30	17.74
40.0	4.4562	8.91	13.37	17.82
.1	4.4785	8.96	13.43	17.91
.2	4.5008	9.00	13.50	18.00
.3	4.5233	9.05	13.57	18.09
.4	4.5457	9.09	13.64	18.18
.5	4.5683	9.14	13.71	18.27
.6	4.5908	9.18	13.77	18.36
.7	4.6135	9.23	13.84	18.45
.8	4.6362	9.27	13.91	18.54
.9	4.6589	9.32	13.98	18.64
41.0	4.6818	9.36	14.05	18.73
.1	4.7046	9.41	14.11	18.82
.2	4.7275	9.45	14.18	18.91
.3	4.7505	9.50	14.25	19.00
.4	4.7735	9.55	14.32	19.09
.5	4.7966	9.59	14.39	19.19
.6	4.8198	9.64	14.46	19.28
.7	4.8430	9.69	14.53	19.37
.8	4.8662	9.73	14.60	19.46
.9	4.8895	9.78	14.67	19.56

Contents of Cylinders, *&c.*

DEPTH.				
5	6	7	8	9
21.18	25.42	29.65	33.89	38.12
21.29	25.55	29.81	34.06	38.32
21.40	25.68	29.95	34.23	38.51
21.51	25.81	30.11	34.41	38.71
21.62	25.94	30.26	34.58	38.91
21.73	26.07	30.42	34.76	39.11
21.84	26.20	30.57	34.94	39.30
21.95	26.33	30.72	35.11	39.50
22.06	26.47	30.89	35.30	39.71
22.17	26.60	31.04	35.47	39.91
22.28	26.74	31.19	35.65	40.11
22.39	26.87	31.35	35.83	40.30
22.50	27.00	31.51	36.01	40.51
22.62	27.14	31.66	36.18	40.71
22.73	27.28	31.82	36.37	40.91
22.84	27.41	31.98	36.54	41.11
22.95	27.55	32.14	36.73	41.32
23.07	27.68	32.29	36.91	41.52
23.18	27.82	32.45	37.09	41.72
23.30	27.95	32.61	37.27	41.93
23.41	28.09	32.77	37.46	42.14
23.52	28.22	32.93	37.63	42.34
23.64	28.36	33.09	37.82	42.54
23.75	28.50	33.25	38.00	42.75
23.87	28.64	33.41	38.19	42.96
23.98	28.78	33.57	38.37	43.17
24.10	28.92	33.74	38.56	43.38
24.22	29.06	33.90	38.74	43.59
24.33	29.19	34.06	38.93	43.80
24.45	29.34	34.23	39.11	44.00

Areas of Circles and

Diam. in Inches.	DEPTH.			
	1	2	3	4
42.0	4.9129	9.83	14.74	19.65
.1	4.9363	9.87	14.81	19.74
.2	4.9598	9.92	14.88	19.84
.3	4.9834	9.97	14.95	19.93
.4	5.0069	10.01	15.02	20.03
.5	5.0306	10.06	15.09	20.12
.6	5.0543	10.11	15.16	20.22
.7	5.0780	10.16	15.23	20.31
.8	5.1019	10.20	15.31	20.41
.9	5.1257	10.25	15.38	20.50
43.0	5.1496	10.30	15.45	20.60
.1	5.1736	10.35	15.52	20.69
.2	5.1977	10.40	15.59	20.79
.3	5.2218	10.44	15.67	20.89
.4	5.2459	10.49	15.74	20.99
.5	5.2701	10.54	15.81	21.08
.6	5.2944	10.59	15.88	21.18
.7	5.3187	10.64	15.96	21.28
.8	5.3430	10.69	16.03	21.37
.9	5.3675	10,74	16.10	21.47
44.0	5.3920	10.78	16.18	21.57
.1	5.4165	10.83	16.25	21.67
.2	5.4411	10.88	16.32	21.76
.3	5.4657	10.93	16.40	21.86
.4	5.4904	10.98	16.47	21.96
.5	5.5152	11.03	16.55	22.06
.6	5.5400	11.08	16.62	22.16
.7	5.5649	11.13	16.70	22.26
.8	5.5898	11.18	16.77	22.36
.9	5.6148	11.23	16.85	22.46

Contents of Cylinders, *&c.*

DEPTH.				
5	6	7	8	9
24.57	29.48	34.39	39.30	44.22
24.68	29.62	34.55	39.49	44.43
24.80	29.76	34.72	39.68	44.64
24.92	29.90	34.88	39.86	44.85
25.04	30.04	35.05	40.06	45.06
25.16	30.19	35.22	40.25	45.28
25.27	30.33	35.38	40.43	45.49
25.39	30.47	35.55	40.62	45.70
25.51	30.61	35.72	40.82	45.92
25.63	30.76	35.88	41.01	46.14
25.75	30.90	36.05	41.19	46.34
25.87	31.04	36.21	41.39	46.56
25.99	31.19	36.39	41.59	46.78
26.11	31.33	36.56	41.78	47.00
26.23	31.48	36.72	41.97	47.22
26.35	31.62	36.89	42.16	47.43
26.47	31.77	37.06	42.35	47.65
26.59	31.91	37.23	42.55	47.87
26.72	32.06	37.40	42.75	48.09
26.84	32.20	37.57	42.94	48.31
26.96	32.35	37.74	43.14	48.53
27.08	32.50	37.91	43.33	48.75
27.21	32.65	37.09	43.53	48.97
27.33	32.80	38.26	43.73	49.19
27.45	32.94	38.43	43.92	49.41
27.58	33.09	38.61	44.12	49.64
27.70	33.24	38.78	44.32	49.86
27.83	33.39	38.96	44.52	50.09
27.95	33.54	39.13	44.72	50.31
28.08	33.69	39.31	44.92	50.54

Areas of Circles and

Diam. in Inches.	DEPTH.			
	1	2	3	4
45.0	5.6398	11.28	16.92	22.56
.1	5.6649	11.33	17.00	22.66
.2	5.6901	11.38	17.07	22.76
.3	5.7153	11.43	17.15	22.86
.4	5.7405	11.48	17.22	22.96
.5	5.7659	11.53	17.30	23.06
.6	5.7912	11.58	17.37	23.16
.7	5.8167	11.63	17.45	23.27
.8	5.8421	11.68	17.53	23.37
.9	5.8677	11.74	17.60	23.47
46.0	5.8933	11.79	17.68	23.57
.1	5.9189	11.84	17.76	23.68
.2	5.9446	11.89	17.84	23.78
.3	5.9704	11.94	17.91	23.88
.4	5.9962	11.99	17.99	23.98
.5	6.0221	12.04	18.07	24.09
.6	6.0480	12.10	18.14	24.19
.7	6.0740	12.15	18.22	24.30
.8	6.1000	12.20	18.30	24.40
.9	6.1261	12.25	18.38	24.50
47.0	6.1523	12.30	18.46	24.61
.1	6.1735	12.36	18.54	24.71
.2	6.2048	12.41	18.61	24.82
.3	6.2311	12.46	18.69	24.92
.4	6.2575	12.52	18.78	25.03
.5	6.2839	12.57	18.85	25.14
.6	6.3104	12.62	18.93	25.24
.7	6.3369	12.67	19.01	25.35
.8	6.3635	12.73	19.09	25.45
.9	6.3902	12.78	19.17	25.56

Contents of Cylinders, *&c.*

DEPTH				
5	6	7	8	9
28.20	33.84	39.48	45.12	50.76
28.33	33.99	39.66	45.32	50.99
28.45	34.14	39.83	45.52	51.21
28.58	34.29	40.01	45.72	51.44
28.70	34.44	40.18	45.92	51.66
28.83	34.60	40.36	46.13	51.90
28.96	34.75	40.54	46.33	52.12
29.09	34.90	40.72	46.54	52.35
29.21	35.05	40.90	46.74	52.58
29.34	35.21	41.08	46.94	52.81
29.47	35.36	41.25	47.15	53.04
29.60	35.51	41.43	47.35	53.27
29.73	35.67	41.62	47.56	53.51
29.85	35.82	41.79	47.76	53.73
29.98	35.98	41.97	47.97	53.97
30.11	36.13	42.15	48.18	54.20
30.24	36.29	42.34	48.38	54.43
30.37	36.44	42.52	48.59	54.67
30.50	36.60	42.70	48.80	54.90
30.63	36.76	42.88	49.01	55.13
30.76	36.91	43.07	49.22	55.37
30.89	37.07	43.25	49.43	55.60
31.03	37.23	43.44	49.64	55.85
31.16	37.39	43.62	49.85	56.08
31.29	37.55	43.81	50.07	56.32
31.42	37.71	43.99	50.27	56.56
31.55	37.86	44.17	50.48	56.79
31.69	38.02	44.36	50.70	57.03
31.82	38.18	44.54	50.91	57.27
31.95	38.34	44.73	51.12	57.51

Areas of Circles and

Diam. in Inches.	DEPTH.			
	1	2	3	4
48.0	6.4169	12.83	19.25	25.67
.1	6.4436	12.89	19.33	25.78
.2	6.4705	12.94	19.41	25.88
.3	6 4973	12.99	19.49	25.99
.4	6.5243	13.05	19.57	26.10
.5	6.5513	13.10	19.65	26.20
.6	6.5783	13.16	19.74	26.31
.7	6.6054	13.21	19.82	26.42
.8	6.6325	13.27	19.90	26.53
.9	6.6600	13.32	19.98	26.64
49.0	6.6870	13.37	20.06	26.74
.1	6.7143	13.43	20.14	26.86
.2	6.7417	13.48	20.23	26.97
.3	6.7692	13.54	20.31	27.08
.4	6.7966	13.59	20.39	27.19
.5	6.8242	13.65	20.47	27.30
.6	6.8518	13.70	20.56	27.41
.7	6.8794	13.76	20.64	27.52
.8	6.9072	13.81	20.72	27.63
.9	6.9349	13.87	20.81	27.74
50.0	6.9628	13.93	20.89	27.85
.1	6.9906	13.98	20.97	27.96
.2	7.0186	14.04	21.06	28.08
.3	7.0466	14.09	21.14	28.19
.4	7.0746	14.15	21.22	28.30
.5	7.1027	14.21	21.31	28.41
.6	7.1309	14.26	21.39	28.52
.7	7.1591	14.32	21.48	28.64
.8	7.1873	14.38	21.56	28.75
.9	7.2157	14.43	21.65	28.86

Contents of Cylinders, *&c.*

DEPTH.				
5	6	7	8	9
32.08	38.50	44.92	51.34	57.75
32.22	38.66	45.11	51.55	58.00
32.35	38.82	45.29	51.76	58.23
32.49	38.98	45.48	51.98	58.48
32.62	39.15	45.67	52.19	58.72
32.76	39.31	45.86	52.41	58.96
32.89	39.47	46.05	52.63	59.20
33.03	39.63	46.24	52.84	59.45
33.16	39.79	46.43	53.06	59.69
33.30	39.96	46.62	53.28	59.94
33.43	40.12	46.80	53.49	60.18
33.57	40.29	47.00	53.71	60.43
33.71	40.45	47.20	53.94	60.68
33.85	40.61	47.38	54.15	60.92
33.99	40.78	47.58	54.38	61.17
34.12	40.95	47.77	54.59	61.42
34.26	41.11	47.97	54.82	61.67
34.40	41.28	48.15	55.03	61.91
34.54	41.44	48.35	55.26	62.16
34.68	41.61	48.55	55.48	62.42
34.82	41.78	48.74	55.71	62.66
34.96	41.95	48.94	55.93	62.92
35.10	42.11	49.13	56.15	63.17
35.24	42.28	49.33	56.38	63.42
35.38	42.45	49.53	56.60	63.68
35.52	42.62	49.72	56.83	63.93
35.66	42.79	49.92	57.05	64.18
35.80	42.96	50.11	57.27	64.43
35.94	43.12	50.31	57.50	64.69
36.08	43.30	50.51	57.73	64.94

Areas of Circles and

Diam. in Inches.	DEPTH.			
	1	2	3	4
51.0	7.2440	14 49	21.73	28 98
.1	7.2725	14.55	21.82	29.09
.2	7.3010	14 60	21.90	29.20
.3	7.3295	14.66	21.99	29.32
.4	7.3581	14.72	22.07	29.43
.5	7.3868	14 77	22.16	29.55
.6	7.4155	14.83	22.25	29.66
.7	7.4443	14.89	22.33	29.78
.8	7.4731	14.95	22.42	29 89
.9	7.5020	15.00	22.51	30.01
52.0	7.5309	15.06	22.59	30.12
.1	7.5599	15.12	22.68	30.24
.2	7.5890	15.18	22.77	30.36
.3	7.6181	15 24	22.86	30.47
.4	7.6472	15.29	22.94	30.59
.5	7.6764	15.35	23.03	30.71
.6	7.7057	15.41	23.12	30.83
.7	7.7350	15.47	23.21	30.94
.8	7.7644	15.53	23.29	31.06
.9	7.7939	15.59	23.38	31.18
53.0	7.8233	15.65	23.47	31.29
.1	7.8529	15.71	23.56	31.41
.2	7.8825	15.76	23.65	31.53
.3	7.9122	15.82	23.74	31.65
.4	7.9419	15.88	23.83	31.77
.5	7.9717	15.94	23.92	31.89
.6	8.0015	16.00	24.00	32.01
.7	8.0314	16.06	24.09	32.13
.8	8.0613	16.12	24.18	32.24
.9	8.0913	16.18	24.27	32.36

Contents of Cylinders, *&c.*

DEPTH.				
5	6	7	8	9
36.22	43.47	50.71	57.95	65.20
36.36	43.63	50.91	58.18	65.45
36.51	43.81	51.11	58.41	65.71
36.65	43.97	51.30	58.63	65.96
36.79	44.15	51.51	58.87	66.22
36.94	44.32	51.71	59.10	66.48
37.08	44.49	51.91	59.32	66.74
37.22	44.66	52.11	59.55	67.00
37.37	44.84	52.31	59.79	67.26
37.51	45.01	52.52	60.02	67.52
37.66	45.19	52.72	60.25	67.78
37.80	45.36	52.92	60.48	68.04
37.95	45.53	53.12	60.71	68.30
38.09	45.71	53.33	60.95	68.56
38.24	45.88	53.53	61.18	68.82
38.38	46.06	53.73	61.41	69.09
38.53	46.24	53.94	61.65	69.36
38.68	46.41	54.15	61.88	69.62
38.82	46.59	54.35	62.11	69.88
38.97	46.76	54.56	62.35	70.15
39.12	46.94	54.76	62.59	70.41
39.27	47.12	54.97	62.82	70.68
39.41	47.29	55.18	63.06	70.94
39.56	47.47	55.39	63.30	71.21
39.71	47.65	55.60	63.54	71.48
39.86	47.83	55.81	63.78	71.75
40.01	48.01	56.01	64.01	72.01
40.16	48.19	56.22	64.25	72.28
40.31	48.37	56.43	64.49	72.55
40.46	48.55	56.64	64.73	72.82

Areas of Circles and

Diam. in Inches.	DEPTH.			
	1	2	3	4
54.0	8.1214	16.24	24.36	32.49
.1	8.1515	16.30	24.45	32.61
.2	8.1816	16.36	24.54	32.72
.3	8.2118	16.42	24.64	32.85
.4	8.2421	16.48	24.73	32.97
.5	8.2724	16.54	24.82	33.09
.6	8.3028	16.61	24.91	33.22
.7	8.3333	16.67	25.00	33.33
.8	8.3638	16.72	25.09	33.46
.9	8.3943	16.79	25.18	33.58
55.0	8.4249	16.85	25.27	33.70
.1	8.4556	16.91	25.37	33.82
.2	8.4863	16.97	25.46	33.95
.3	8.5171	17.03	25.55	34.07
.4	8.5479	17.10	25.64	34.19
.5	8.5788	17.16	25.74	34.32
.6	8.6097	17.22	25.83	34.44
.7	8.6407	17.28	25.92	34.56
.8	8.6718	17.34	26.01	34.68
.9	8.7029	17.40	26.11	34.81
56.0	8.7341	17.47	26.20	34.94
.1	8.7653	17.53	26.30	35.06
.2	8.7966	17.59	26.39	35.19
.3	8.8279	17.66	26.48	35.31
.4	8.8593	17.72	26.58	35.44
.5	8.8907	17.78	26.67	35.56
.6	8.9222	17.84	26.77	35.69
.7	8.9538	17.91	26.86	35.82
.8	8.9854	17.97	26.96	35.94
.9	9.0171	18.03	27.05	36.07

Contents of Cylinders, *&c.*

DEPTH.				
5.	6	7	8	9
40.61	48.73	56.85	64.97	73.09
40.76	48.91	57.06	65.21	73.36
40.91	49.09	57.27	65.45	73.63
41.06	49.27	57.49	65.70	73.91
41.21	49.45	57.70	65.94	74.18
41.36	49.63	57.91	66.18	74.45
41.52	49.82	58.12	66.43	74.73
41.67	50.00	58.33	66.67	75.00
41.82	50.19	58.55	66.91	75.28
41.97	50.37	58.76	67.15	75.55
42.12	50.55	58.98	67.40	75.83
42.28	50.74	59.19	67.65	76.11
42.43	50.92	59.40	67.89	76.38
42.59	51.10	59.62	68.14	76.66
42.74	51.29	59.84	68.39	76.93
42.90	51.48	60.05	68.63	77.21
43.05	51.66	60.27	68.88	77.49
43.20	51.85	60.49	69.13	77.77
43.36	52.03	60.70	69.37	78.04
43.52	52.22	60.92	69.62	78.33
43.67	52.40	61.14	69.87	78.61
43.83	52.59	61.36	70.12	78.89
43.99	52.78	61.58	70.38	79.18
44.14	52.97	61.80	70.62	79.45
44.30	53.16	62.01	70.87	79.73
44.46	53.35	62.24	71.13	80.02
44.61	53.53	62.46	71.38	80.30
44.77	53.72	62.68	71.63	80.59
44.93	53.91	62.90	71.88	80.87
45.09	54.10	63.12	72.14	81.15

Areas of Circles and

Diam. in Inches.	DEPTH. 1	2	3	4
57.0	9.0489	18.10	27.15	36.20
.1	9.0806	18.16	27.24	36.32
.2	9.1124	18.22	27.34	36.45
.3	9.1443	18.29	27.43	36.58
.4	9.1762	18.35	27.53	36.71
.5	9.2082	18.42	27.62	36.83
.6	9.2403	18.48	27.72	36.96
.7	9.2724	18.54	27.82	37.09
.8	9.3046	18.61	27.91	37.22
.9	9.3368	18.67	28.01	37.35
58.0	9.3691	18.74	28.11	37.48
.1	9.4014	18.80	28.20	37.60
.2	9.4338	18.87	28.30	37.74
.3	9.4662	18.93	28.40	37.86
.4	9.4988	19.00	28.50	38.00
.5	9.5313	19.06	28.59	38.12
.6	9.5639	19.13	28.69	38.26
.7	9.5966	19.19	28.79	38.38
.8	9.6293	19.26	28.89	38.52
.9	9.6621	19.32	28.99	38.65
59.0	9.6949	19.39	29.08	38.78
.1	9.7278	19.46	29.19	38.91
.2	9.7608	19.52	29.28	39.04
.3	9.7938	19.59	29.38	39.18
.4	9.8268	19.65	29.48	39.31
.5	9.8600	19.72	29.58	39.44
.6	9.8931	19.79	29.68	39.57
.7	9.9263	19.85	29.78	39.70
.8	9.9596	19.92	29.88	39.84
.9	9.9930	19.99	29.98	39.97

Contents of Cylinders, *&c.*

DEPTH.				
5	6	7	8	9
45.25	54.29	63.34	72.39	81.44
45.40	54.48	63.56	72.65	81.73
45.56	54.67	63.79	72.90	82.01
45.72	54.87	64.01	73.15	82.30
45.88	55.06	64.23	73.41	82.59
46.04	55.25	64.46	73.67	82.87
46.20	55.44	64.68	73.92	83.16
46.36	55.63	64.91	74.18	83.45
46.52	55.83	65.13	74.43	83.74
46.69	56.02	65.36	74.70	84.03
46.85	56.21	65.58	74.95	84.32
47.01	56.41	65.81	75.21	84.61
47.17	56.60	66.04	75.47	84.91
47.33	56.80	66.26	75.73	85.20
47.50	56.99	66.49	75.99	85.49
47.66	57.19	66.72	76.25	85.78
47.82	57.38	66.95	76.51	86.08
47.98	57.58	67.17	76.77	86.37
48.15	57.77	67.40	77.03	86.66
48.31	57.97	67.63	77.30	86.96
48.48	58.17	67.87	77.56	87.26
48.64	58.37	68.10	77.82	87.55
48.81	58.57	68.33	78.09	87.85
48.97	58.77	68.56	78.35	88.15
49.14	58.96	68.79	78.62	88.44
49.30	59.16	69.02	78.88	88.74
49.47	59.36	69.25	79.15	89.04
49.63	59.56	69.48	79.41	89.34
49.80	59.75	69.71	79.67	89.63
49.97	59.96	69.95	79.95	89.94

Areas of Circles and

Diam. in Inches.	DEPTH.			
	1	2	3	4
60.0	10.0264	20.05	30.08	40.10
.1	10.0598	20.12	30.18	40.24
.2	10.0933	20.19	30.28	40.37
.3	10.1269	20.25	30.38	40.51
.4	10.1605	20.32	30.48	40.64
.5	10.1942	20.39	30.58	40.78
.6	10.2279	20.46	30.68	40.91
.7	10.2617	20.52	30.78	41.04
.8	10.2955	20.59	30.89	41.18
.9	10.3294	20.66	30.99	41.32
61.0	10.3634	20.73	31.09	41.45
.1	10.3974	20.80	31.19	41.59
.2	10.4314	20.86	31.29	41.72
.3	10.4655	20.93	31.40	41.86
.4	10.4997	21.00	31.50	42.00
.5	10.5339	21.07	31.60	42.14
.6	10.5682	21.14	31.70	42.27
.7	10.6026	21.21	31.81	42.41
.8	10.6370	21.27	31.91	42.55
.9	10.6714	21.34	32.01	42.68
62.0	10.7059	21.41	32.11	42.82
.1	10.7405	21.48	32.22	42.96
.2	10.7751	21.55	32.33	43.10
.3	10.8098	21.62	32.43	43.24
.4	10.8445	21.69	32.53	43.38
.5	10.8793	21.76	32.64	43.52
.6	10.9141	21.83	32.74	43.66
.7	10.9490	21.90	32.85	43.80
.8	10.9840	21.97	32.95	43.94
.9	11.0190	22.04	33.06	44.08

Contents of Cylinders, &c.

DEPTH.				
5	6	7	8	9
50.13	60.16	70.18	80.21	90.23
50.30	60.36	70.42	80.48	90.54
50.47	60.56	70.65	80.75	90.84
50.64	60.76	70.89	81.02	91.14
50.80	60.96	71.12	81.28	91.45
50.97	61.17	71.36	81.55	91.75
51.14	61.37	71.60	81.82	92.05
51.31	61.57	71.83	82.09	92.35
51.48	61.77	72.07	82.36	92.66
51.65	61.97	72.30	82.63	92.96
51.81	62.18	72.54	82.90	93.27
51.99	62.38	72.78	83.18	93.58
52.16	62.59	73.02	83.45	93.88
52.33	62.79	73.26	83.72	94.19
52.50	63.00	73.50	84.00	94.50
52.67	63.20	73.74	84.27	94.81
52.84	63.41	73.98	84.55	95.11
53.02	63.62	74.22	84.82	95.43
53.19	63.82	74.46	85.10	95.73
53.36	64.03	74.70	85.37	96.04
53.53	64.24	74.94	85.65	96.35
53.70	64.44	75.18	85.92	96.66
53.88	64.65	75.43	86.20	96.98
54.05	64.86	75.67	86.48	97.29
54.22	65.06	75.91	86.75	97.60
54.40	65.27	76.15	87.03	97.91
54.57	65.48	76.40	87.31	98.23
54.75	65.69	76.64	87.59	98.54
54.92	65.91	76.89	87.87	98.86
55.10	66.11	77.13	88.15	99.17

Areas of Circles and

Diam. in Inches	DEPTH.			
	1	2	3	4
63.0	11.0541	22.11	33.16	44.22
.1	11.0892	22.18	33.27	44.36
.2	11.1244	22.25	33.37	44.50
.3	11.1596	22.32	33.48	44.64
.4	11.1949	22.39	33.59	44.78
.5	11.2302	22.46	33.69	44.92
.6	11.2656	22.53	33.79	45.06
.7	11.3011	22.60	33.90	45.20
.8	11.3366	22.67	34.01	45.35
.9	11.3721	22.74	34.12	45.49
64.0	11.4078	22.82	34.22	45.63
.1	11.4434	22.89	34.33	45.77
.2	11.4792	22.96	34.44	45.92
.3	11.5150	23.03	34.54	46.06
.4	11.5508	23.10	34.65	46.20
.5	11.5867	23.17	34.76	46.35
.6	11.6227	23.25	34.87	46.49
.7	11.6587	23.32	34.98	46.64
.8	11.6947	23.39	35.08	46.78
.9	11.7309	23.46	35.19	46.92
65.0	11.7670	23.53	35.30	47.07
.1	11.8033	23.60	35.40	47.21
.2	11.8396	23.68	35.52	47.36
.3	11.8759	23.75	35.62	47.50
.4	11.9123	23.82	35.74	47.65
.5	11.9488	23.90	35.85	47.80
.6	11.9853	23.97	35.96	47.94
.7	12.0219	24.04	36.07	48.09
.8	12.0585	24.12	36.17	48.23
.9	12.0952	24.19	36.28	48.38

Contents of Cylinders, &c.

DEPTH				
5	6	7	8	9
55.27	66.32	77.38	88.43	99.49
55.45	66.53	77.62	88.71	99.80
55.62	66.75	77.87	88.99	100.12
55.80	66.96	78.12	89.28	100.44
55.98	67.17	78.37	89.56	100.76
56.15	67.38	78.61	89.84	101.07
56.33	67.60	78.86	90.13	101.40
56.51	67.81	79.11	90.41	101.71
56.69	68.02	79.36	90.70	102.03
56.86	68.23	79.60	90.98	102.35
57.04	68.45	79.86	91.26	102.67
57.22	68.66	80.10	91.54	102.99
57.40	68.87	80.35	91.83	103.31
57.57	69.09	80.61	92.12	103.64
57.75	69.31	80.86	92.41	103.96
57.94	69.52	81.11	92.70	104.28
58.12	69.74	81.36	92.98	104.61
58.30	69.95	81.61	93.27	104.93
58.47	70.17	81.87	93.56	105.26
58.65	70.39	82.12	93.85	105.58
58.84	70.60	82.37	94.14	105.90
59.01	70.81	82.62	94.42	106.22
59.20	71.04	82.88	94.72	106.56
59.38	71.26	83.13	95.01	106.88
59.56	71.47	83.38	95.30	107.21
59.75	71.69	83.64	95.60	107.54
59.93	71.91	83.90	95.88	107.87
60.11	72.13	84.15	96.18	108.20
60.29	72.35	84.41	96.46	108.52
60.48	72.57	84.67	96.76	108.86

Areas of Circles and

Diam. in Inches.	DEPTH.			
	1	2	3	4
66.0	12.1319	24.26	36.40	48.53
.1	12.1687	24.34	36.51	48.68
.2	12.2055	24.41	36.62	48.82
.3	12.2424	24.48	36.73	48.97
.4	12.2794	24.56	36.84	49.12
.5	12.3164	24.63	36.95	49.27
.6	12.3535	24.71	37.06	49.41
.7	12.3906	24.78	37.17	49.56
.8	12.4278	24.86	37.28	49.71
.9	12.4650	24.93	37.40	49.86
67.0	12.5023	25.00	37.51	50.01
.1	12.5397	25.08	37.62	50.16
.2	12.5771	25.15	37.73	50.31
.3	12.6145	25.23	37.84	50.46
.4	12.6520	25.30	37.96	50.61
.5	12.6896	25.38	38.07	50.76
.6	12.7272	25.45	38.18	50.91
.7	12.7649	25.53	38.30	51.06
.8	12.8027	25.61	38.41	51.21
.9	12.8405	25.68	38.52	51.36
68.0	12.8783	25.76	38.63	51.51
.1	12.9162	25.83	38.75	51.66
.2	12.9542	25.91	38.86	51.82
.3	12.9922	25.98	38.98	51.97
.4	13.0303	26.06	39.09	52.12
.5	13.0684	26.14	39.20	52.27
.6	13.1066	26.21	39.32	52.42
.7	13.1448	26.29	39.44	52.58
.8	13.1831	26.37	39.55	52.73
.9	13.2315	26.44	39.66	52.88

Contents of Cylinders, *&c.*

DEPTH.				
5	6	7	8	9
60.66	72.79	84.92	97.06	109.19
60.85	73.01	85.18	97.35	109.52
61.03	73.23	85.44	97.64	109.85
61.21	73.45	85.69	97.94	110.18
61.40	73.67	85.95	98.23	110.51
61.58	73.90	86.21	98.53	110.84
61.77	74.12	86.47	98.83	111.18
61.95	74.34	86.73	99.12	111.51
62.14	74.57	87.00	99.42	111.85
62.33	74.79	87.26	99.72	112.19
62.51	75.01	87.51	100.02	112.52
62.70	75.24	87.78	100.32	112.86
62.89	75.46	88.04	100.62	113.19
63.07	75.68	88.30	100.91	113.53
63.26	75.91	88.56	101.22	113.87
63.45	76.13	88.82	101.51	114.20
63.64	76.36	89.09	101.82	114.54
63.83	76.59	89.36	102.12	114.89
64.02	76.82	89.62	102.42	115.23
64.20	77.04	89.88	102.72	115.56
64.39	77.27	90.14	103.02	115.90
64.58	77.50	90.41	103.33	116.24
64.77	77.72	90.68	103.63	116.59
64.96	77.95	90.94	103.94	116.93
65.15	78.18	91.21	104.24	117.27
65.34	78.41	91.48	104.54	117.61
65.53	78.64	91.74	104.85	117.95
65.73	78.87	92.02	105.16	118.31
65.92	79.10	92.28	105.47	118.65
66.11	79.33	92.55	105.77	118.90

Areas of Circles and

Diam. in Inches.	DEPTH.			
	1	2	3	4
69.0	13.2599	26.52	39.78	53.04
.1	13.2983	26.60	39.89	53.19
.2	13.3368	26.67	40.01	53.35
.3	13.3754	26.75	40.13	53.50
.4	13.4140	26.83	40.24	53.66
.5	13.4527	26.91	40.36	53.81
.6	13.4915	26.98	40.47	53.96
.7	13.5303	27.06	40.59	54.12
.8	13.5691	27.14	40.71	54.28
.9	13.6080	27.22	40.82	54.43
70.0	13.6470	27.29	40.94	54.59
.1	13.6860	27.37	41.06	54.74
.2	13.7251	27.45	41.18	54.90
.3	13.7642	27.53	41.29	55.06
.4	13.8034	27.61	41.41	55.21
.5	13.8426	27.68	41.53	55.37
.6	13.8819	27.76	41.65	55.53
.7	13.9213	27.84	41.76	55.68
.8	13.9607	27.92	41.88	55.84
.9	14.0002	28.00	42.00	56.00
71.0	14.0397	28.08	42.12	56.16
.1	14.0793	28.16	42.24	56.32
.2	14.1189	28.24	42.36	56.48
.3	14.1586	28.32	42.47	56.63
.4	14.1983	28.40	42.59	56.79
.5	14.2381	28.48	42.71	56.95
.6	14.2780	28.56	42.83	57.11
.7	14.3179	28.64	42.95	57.27
.8	14.3579	28.72	43.07	57.43
.9	14.3979	28.80	43.19	57.59

Contents of Cylinders, &c.

DEPTH.				
5	6	7	8	9
66.30	79.56	92.82	106.08	119.34
66.49	79.79	93.09	106.38	119.68
66.69	80.02	93.36	106.70	120.03
66.88	80.25	93.63	107.00	120.38
67.07	80.48	93.90	107.31	120.73
67.27	80.72	94.17	107.62	121.08
67.46	80.95	94.44	107.93	121.42
67.65	81.18	94.71	108.24	121.77
67.85	81.41	94.98	108.55	122.12
68.04	81.65	95.26	108.86	122.47
68.24	81.88	95.53	109.18	122.82
68.43	82.12	95.80	109.49	123.17
68.63	82.35	96.08	109.80	123.53
68.82	82.58	96.35	110.11	123.88
69.02	82.82	96.62	110.42	124.23
69.21	83.05	96.89	110.74	124.58
69.41	83.29	97.17	111.06	124.94
69.61	83.53	97.45	111.37	125.29
69.81	83.77	97.73	111.69	125.65
70.00	84.00	98.00	112.00	126.00
70.20	84.24	98.28	112.32	126.36
70.40	84.47	98.55	112.63	126.71
70.60	84.71	98.83	112.95	127.07
70.79	84.95	99.11	113.26	127.42
70.99	85.19	99.39	113.58	127.78
71.19	85.43	99.67	113.90	128.14
71.39	85.67	99.95	114.22	128.50
71.59	85.91	100.23	114.54	128.86
71.79	86.15	100.51	114.86	129.22
71.99	86.39	100.78	115.18	129.58

Areas of Circles and

Diam. in Inches.	DEPTH.			
	1	2	3	4
72.0	14.4380	28.88	43.31	57.75
.1	14.4781	28.96	43.43	57.91
.2	14.5183	29.04	43.55	58.07
.3	14.5585	29.12	43.67	58.23
.4	14.5988	29.20	43.80	58.40
.5	14.6392	29.28	43.92	58.56
.6	14.6796	29.36	44.04	58.72
.7	14.7201	29.44	44.16	58.88
.8	14.7606	29.52	44.28	59.04
.9	14.8012	29.60	44.40	59.20
73.0	14.8418	29.68	44.53	59.37
.1	14.8825	29.76	44.65	59.53
.2	14.9232	29.85	44.77	59.69
.3	14.9640	29.93	44.89	59.86
.4	15.0049	30.01	45.02	60.02
.5	15.0458	30.09	45.14	60.18
.6	15.0868	30.17	45.26	60.35
.7	15.1278	30.26	45.38	60.51
.8	15.1689	30.34	45.51	60.68
.9	15.2100	30.42	45.63	60.84
74.0	15.2512	30.50	45.75	61.00
.1	15.2925	30.58	45.88	61.17
.2	15.3338	30.67	46.00	61.34
.3	15.3751	30.75	46.13	61.50
.4	15.4165	30.83	46.25	61.66
.5	15.4580	30.92	46.37	61.83
.6	15.4950	30.99	46.49	61.98
.7	15.5411	31.08	46.62	62.16
.8	15.5827	31.17	46.75	62.33
.9	15.6244	31.25	46.87	62.50

Contents of Cylinders, *&c.*

DEPTH.				
5	6	7	8	9
72.19	86.63	101.07	115.50	129.94
72.39	86.87	101.35	115.82	130.30
72.59	87.11	101.63	116.14	130.66
72.79	87.35	101.91	116.46	131.02
73.00	87.59	102.19	116.79	131.39
73.20	87.83	102.47	117.11	131.75
73.40	88.07	102.75	117.43	132.11
73.60	88.32	103.04	117.76	132.48
73.80	88.56	103.32	118.08	132.84
74.01	88.81	103.61	118.41	133.21
74.21	89.05	103.89	118.74	133.58
74.41	89.29	104.17	119.06	133.94
74.62	89.54	104.46	119.38	134.31
74.82	89.78	104.75	119.71	134.68
75.03	90.03	105.04	120.04	135.05
75.23	90.28	105.32	120.37	135.41
75.44	90.52	105.61	120.70	135.78
75.64	90.77	105.90	121.02	136.15
75.85	91.01	106.18	121.35	136.52
76.05	91.26	106.47	121.68	136.89
76.26	91.51	106.76	122.01	137.26
76.46	91.75	107.04	122.34	137.63
76.67	92.00	107.34	122.67	138.01
76.88	92.25	107.63	123.00	138.38
77.08	92.50	107.91	123.33	138.74
77.29	92.75	108.21	123.66	139.12
77.48	92.97	108.47	123.96	139.46
77.71	93.25	108.79	124.33	139.87
77.92	93.50	109.08	124.66	140.25
78.12	93.74	109.37	124.99	140.62

Areas of Circles and

Diam. in Inches.	DEPTH.			
	1	2	3	4
75.0	15.6662	31.33	47.00	62.66
.1	15.7080	31.42	47.12	62.83
.2	15.7499	31.50	47.25	63.00
.3	15.7918	31.58	47.38	63.17
.4	15.8337	31.67	47.50	63.34
.5	15.8758	31.75	47.63	63.50
.6	15.9178	31.84	47.75	63.67
.7	15.9600	31.92	47.88	63.84
.8	16.0022	32.00	48.01	64.01
.9	16.0444	32.09	48.13	64.18
76.0	16.0867	32.17	48.26	64.35
.1	16.1291	32.26	48.39	64.52
.2	16.1715	32.34	48.51	64.68
.3	16.2140	32.43	48.64	64.86
.4	16.2565	32.51	48.77	65.02
.5	16.2991	32.60	48.90	65.20
.6	16.3417	32.68	49.03	65.37
.7	16.3844	32.77	49.15	65.54
.8	16.4272	32.85	49.28	65.71
.9	16.4700	32.94	49.41	65.88
77.0	16.5129	33.03	49.54	66.05
.1	16.5558	33.11	49.67	66.22
.2	16.5988	33.20	49.80	66.40
.3	16.6418	33.28	49.93	66.57
.4	16.6849	33.37	50.06	66.74
.5	16.7280	33.46	50.18	66.91
.6	16.7712	33.54	50.31	67.08
.7	16.8145	33.63	50.44	67.26
.8	16.8578	33.72	50.57	67.43
.9	16.9011	33.80	50.70	67.60

Contents of Cylinders, *&c.*

DEPTH				
5	6	7	8	9
78.33	94.00	109.66	125.33	140.99
78.54	94.25	109.96	125.66	141.37
78.75	94.50	110.25	126.00	141.75
78.96	94.75	110.54	126.34	142.13
79.17	95.00	110.84	126.67	142.51
79.38	95.26	111.13	127.01	142.88
79.59	95.51	111.43	127.34	143.26
79.80	95.76	111.72	127.68	143.64
80.01	96.01	112.01	128.02	144.02
80.22	96.26	112.31	128.35	144.40
80.44	96.52	112.61	128.70	144.78
80.65	96.77	112.90	129.03	145.16
80.86	97.03	113.20	129.37	145.54
81.07	97.28	113.50	129.71	145.93
81.28	97.54	113.79	130.05	146.30
81.50	97.80	114.10	130.40	146.70
81.71	98.05	114.39	130.74	147.08
81.92	98.30	114.69	131.07	147.46
82.14	98.56	114.99	131.42	147.84
82.35	98.82	115.29	131.76	148.23
82.57	99.08	115.59	132.10	148.62
82.78	99.34	115.89	132.45	149.00
83.00	99.59	116.19	132.79	149.39
83.21	99.85	116.49	133.14	149.78
83.43	100.11	116.80	133.48	150.17
83.64	100.37	117.10	133.82	150.55
83.86	100.63	117.40	134.17	150.94
84.07	100.88	117.70	134.51	151.33
84.29	101.15	118.01	134.86	151.72
84.51	101.41	118.31	135.21	152.11

Areas of Circles and

Diam. in Inches	DEPTH.			
	1	2	3	4
78.0	16.9445	33.89	50.83	67.78
.1	16.9880	33.98	50.96	67.95
.2	17.0316	34.06	51.09	68.12
.3	17.0751	34.15	51.23	68.30
.4	17.1188	34.24	51.36	68.48
.5	17.1625	34.32	51.49	68.65
.6	17.2062	34.41	51.62	68.82
.7	17.2500	34.50	51.75	69.00
.8	17.2939	34.59	51.88	69.18
.9	17.3378	34.68	52.01	69.35
79.0	17.3818	34.76	52.15	69.53
.1	17.4258	34.85	52.28	69.70
.2	17.4699	34.94	52.41	69.88
.3	17.5141	35.03	52.54	70.06
.4	17.5583	35.12	52.67	70.23
.5	17.6025	35.20	52.81	70.41
.6	17.6468	35.29	52.94	70.59
.7	17.6912	35.38	53.07	70.76
.8	17.7356	35.47	53.21	70.94
.9	17.7801	35.56	53.34	71.12
80.0	17.8246	35.65	53.47	71.30
.1	17.8692	35.74	53.61	71.48
.2	17.9139	35.83	53.74	71.66
.3	17.9586	35.92	53.87	71.83
.4	18.0033	36.01	54.01	72.01
.5	18.0481	36.10	54.14	72.19
.6	18.0930	36.19	54.28	72.37
.7	18.1379	36.28	54.41	72.55
.8	18.1829	36.37	54.55	72.73
.9	18.2280	36.46	54.68	72.01

Contents of Cylinders, *&c.*

DEPTH.				
5	6	7	8	9
84.72	101.66	118.61	135.55	152.50
84.94	101.93	118.92	135.90	152.89
85.16	102.19	119.22	136.25	153.28
85.38	102.45	119.53	136.60	153.68
85.60	102.71	119.83	136.95	154.07
85.81	102.97	120.13	137.30	154.46
86.03	103.24	120.44	137.65	154.85
86.25	103.50	120.75	138.00	155.25
86.47	103.76	121.06	138.35	155.65
86.69	104.03	121.37	138.70	156.04
86.91	104.29	121.67	139.06	156.44
87.13	104.56	121.98	139.41	156.83
87.35	104.82	122.29	139.76	157.23
87.57	105.08	122.60	140.11	157.63
87.79	105.35	122.91	140.46	158.02
88.01	105.61	123.21	140.82	158.42
88.24	105.88	123.53	141.18	158.82
88.46	106.15	123.84	141.53	159.22
88.68	106.41	124.15	141.88	159.62
88.90	106.68	124.46	142.24	160.02
89.12	106.94	124.77	142.59	160.42
89.35	107.21	125.08	142.95	160.82
89.57	107.48	125.40	143.31	161.23
89.79	107.75	125.71	143.66	161.62
90.02	108.02	126.02	144.03	162.03
90.24	108.29	126.34	144.39	162.43
90.47	108.56	126.65	144.74	162.84
90.69	108.83	126.97	145.10	163.24
90.92	109.10	127.28	145.46	163.65
91.14	109.37	127.60	145.82	164.05

Areas of Circles and

Diam. in Inches	DEPTH.			
	1	2	3	4
81.0	18.2730	36.55	54.82	73.09
.1	18.3182	36.64	54.95	73.27
.2	18.3634	36.73	55.09	73.45
.3	18.4086	36.82	55.22	73.63
.4	18.4540	36.91	55.36	73.82
.5	18.4993	37.00	55.50	74.00
.6	18.5448	37.09	55.64	74.18
.7	18.5902	37.18	55.77	74.36
.8	18.6358	37.27	55.91	74.54
.9	18.6814	37.36	56.04	74.72
82.0	18.7270	37.45	56.18	74.91
.1	18.7727	37.55	56.32	75.09
.2	18.8185	37.64	56.45	75.27
.3	18.8643	37.73	56.59	75.46
.4	18.9102	37.82	56.73	75.64
.5	18.9561	37.91	56.87	75.82
.6	19.0021	38.00	57.01	76.01
.7	19.0481	38.10	57.14	76.19
.8	19.0942	38.19	57.28	76.38
.9	19.1403	38.28	57.42	76.56
83.0	19.1866	38.37	57.56	76.74
.1	19.2328	38.47	57.70	76.93
.2	19.2791	38.56	57.84	77.12
.3	19.3255	38.65	57.98	77.30
.4	19.3719	38.74	58.12	77.49
.5	19.4184	38.84	58.25	77.67
.6	19.4650	38.93	58.40	77.86
.7	19.5115	39.02	58.53	78.04
.8	19.5582	39.12	58.67	78.23
.9	19.6049	39.21	58.82	78.42

Contents of Cylinders, &c.

DEPTH				
5	6	7	8	9
91.37	109.64	127.91	146.18	164.46
91.59	109.91	128.23	146.55	164.86
91.82	110.18	128.54	146.91	165.27
92.04	110.45	128.86	147.27	165.67
92.27	110.72	129.18	147.63	166.09
92.50	110.99	129.49	147.99	166.49
92.73	111.27	129.82	148.36	166.91
92.95	111.54	130.13	148.72	167.31
93.18	111.82	130.45	149.09	167.72
93.41	112.09	130.77	149.45	168.13
93.64	112.36	131.09	149.81	168.54
93.87	112.64	131.41	150.18	168.96
94.09	112.91	131.73	150.54	169.36
94.32	113.18	132.05	150.91	169.78
94.55	113.46	132.37	151.28	170.19
94.78	113.74	132.69	151.65	170.60
95.01	114.01	133.01	152.02	171.02
95.24	114.29	133.34	152.39	171.43
95.47	114.56	133.66	152.75	171.85
95.70	114.84	133.98	153.12	172.26
95.93	115.12	134.30	153.49	172.67
96.17	115.40	134.63	153.86	173.10
96.40	115.67	134.95	154.23	173.51
96.63	115.95	135.28	154.60	173.93
96.86	116.23	135.60	154.98	174.35
97.09	116.51	135.93	155.34	174.76
97.33	116.79	136.26	155.72	175.19
97.56	117.07	136.58	156.09	175.60
97.79	117.35	135.91	156.46	176.02
98.03	117.63	137.24	156.84	176.45

Areas of Circles and

Diam. in Inches.	DEPTH.			
	1	2	3	4
84.0	19.6517	39.30	58.96	78.61
.1	19.6985	39.40	59.09	78.79
.2	19.7454	39.49	59.24	78.98
.3	19.7923	39.58	59.38	79.17
.4	19.8393	39.68	59.52	79.36
.5	19.8863	39.77	59.66	79.54
.6	19.9334	39.87	59.80	79.73
.7	19.9806	39.96	59.94	79.92
.8	20.0278	40.06	60.08	80.11
.9	20.0750	40.15	60.23	80.30
85.0	20.1223	40.24	60.37	80.49
.1	20.1697	40.34	60.51	80.68
.2	20.2172	40.43	60.65	80.87
.3	20.2646	40.53	60.79	81.06
.4	20.3122	40.62	60.94	81.25
.5	20.3598	40.72	61.08	81.44
.6	20.4074	40.81	61.22	81.63
.7	20.4551	40.91	61.37	81.82
.8	20.5029	41.01	61.51	82.01
.9	20.5507	41.10	61.65	82.20
86.0	20.5986	41.20	61.79	82.39
.1	20.6465	41.29	61.94	82.58
.2	20.6945	41.39	62.08	82.78
.3	20.7426	41.48	62.23	82.97
.4	20.7907	41.58	62.37	83.16
.5	20.8388	41.68	62.52	83.36
.6	20.8870	41.77	62.66	83.55
.7	20.9353	41.87	62.81	83.74
.8	20.9836	41.97	62.95	83.93
.9	21.0320	42.06	63.10	84.13

Contents of Cylinders, &c.

DEPTH.				
5	6	7	8	9
98.26	117.91	137.56	157.22	176.87
98.49	118.19	137.89	157.58	177.28
98.73	118.47	138.22	157.96	177.71
98.96	118.75	138.54	158.34	178.13
99.20	119.03	138.87	158.71	178.55
99.43	119.32	139.20	159.09	178.97
99.67	119.60	139.53	159.46	179.40
99.90	119.88	139.86	159.84	179.82
100.14	120.17	140.20	160.22	180.25
100.38	120.45	140.53	160.60	180.68
100.61	120.73	140.85	160.98	181.10
100.86	121.02	141.19	161.36	181.53
101.09	121.30	141.52	161.74	181.95
101.32	121.58	141.85	162.11	182.38
101.56	121.87	142.18	162.50	182.81
101.80	122.16	142.52	162.88	183.24
102.04	122.44	142.85	163.26	183.66
102.28	122.73	143.19	163.64	184.10
102.52	123.02	143.52	164.02	184.53
102.76	123.31	143.86	164.41	184.96
102.99	123.59	144.19	164.78	185.38
103.23	123.88	144.52	165.17	185.82
103.47	124.16	144.86	165.55	186.25
103.71	124.45	145.19	165.94	186.68
103.96	124.75	145.54	166.33	187.12
104.20	125.03	145.87	166.71	187.55
104.44	125.32	146.21	167.10	187.98
104.68	125.61	146.55	167.48	188.42
104.92	125.90	146.88	167.86	188.85
105.16	126.19	147.22	168.26	189.29

Areas of Circles and

Diam. in Inches.	DEPTH.			
	1	2	3	4
87.0	21.0804	42.16	63.24	84.32
.1	21.1289	42.26	63.39	84.52
.2	21.1775	42.35	63.53	84.71
.3	21.2261	42.45	63.68	84.90
.4	21.2747	42.55	63.83	85.10
.5	21.3234	42.65	63.97	85.29
.6	21.3722	42.74	64.12	85.49
.7	21.4210	42.84	64.26	85.68
.8	21.4699	42.94	64.41	85.88
.9	21.5188	43.04	64.56	86.08
88.0	21.5678	43.14	64.70	86.27
.1	21.6169	43.23	64.85	86.47
.2	21.6660	43.33	65.00	86.66
.3	21.7151	43.43	65.15	86.86
.4	21.7643	43.53	65.29	87.06
.5	21.8136	43.63	65.44	87.25
.6	21.8629	43.73	65.59	87.45
.7	21.9123	43.82	65.74	87.65
.8	21.9617	43.92	65.89	87.85
.9	22.0112	44.02	66.03	88.04
89.0	22.0608	44.12	66.18	88.24
.1	22.1104	44.22	66.33	88.44
.2	22.1600	44.32	66.48	88.64
.3	22.2098	44.42	66.63	88.84
.4	22.2595	44.52	66.78	89.04
.5	22.3093	44.62	66.93	89.24
.6	22.3592	44.72	67.08	89.44
.7	22.4092	44.82	67.23	89.64
.8	22.4592	44.92	67.38	89.84
.9	22.5092	45.02	67.53	90.04

Contents of Cylinders, &c.

DEPTH.				
5	6	7	8	9
105.40	126.48	147.56	168.64	189.72
105.65	126.77	147.90	169.03	190.16
105.89	127.06	148.24	169.42	190.59
106.13	127.36	148.58	169.81	191.03
106.38	127.65	148.93	170.20	191.48
106.62	127.94	149.26	170.58	191.91
106.86	128.23	149.60	170.98	192.35
107.11	128.53	149.95	171.37	192.79
107.35	128.82	150.29	171.76	193.23
107.60	129.11	150.63	172.15	193.67
107.84	129.41	150.98	172.54	194.11
108.09	129.70	151.32	172.94	194.55
108.33	130.00	151.66	173.33	194.99
108.58	130.29	152.01	173.72	195.44
108.82	130.58	152.35	174.11	195.88
109.07	130.88	152.69	174.50	196.32
109.32	131.18	153.04	174.90	196.77
109.56	131.47	153.38	175.30	197.21
109.81	131.77	153.73	175.70	197.66
110.06	132.07	154.08	176.09	198.10
110.31	132.37	154.43	176.49	198.55
110.55	132.66	154.77	176.88	198.99
110.80	132.96	155.12	177.28	199.44
111.05	133.26	155.47	177.68	199.89
111.30	133.55	155.81	178.07	200.33
111.55	133.85	156.16	178.47	200.78
111.80	134.15	156.51	178.87	201.23
112.05	134.45	156.86	179.27	201.68
112.30	134.75	157.21	179.67	202.13
112.55	135.05	157.56	180.07	202.58

Areas of Circles and

Diam. in Inches.	DEPTH.			
	1	2	3	4
90.0	22.5593	45.12	67.68	90.24
.1	22.6095	45.22	67.83	90.44
.2	22.6597	45.32	67.98	90.64
.3	22.7100	45.42	68.13	90.84
.4	22.7603	45.52	68.28	91.04
.5	22.8107	45.62	68.43	91.24
.6	22.8611	45.72	68.58	91.44
.7	22.9116	45.82	68.73	91.64
.8	22.9621	45.92	68.89	91.85
.9	23.0128	46.03	69.04	92.05
91.0	23.0634	46.13	69.19	92.25
.1	23.1141	46.23	69.34	92.46
.2	23.1649	46.33	69.50	92.66
.3	23.2157	46.43	69.65	92.86
.4	23.2666	46.53	69.80	93.06
.5	23.3176	46.63	69.95	93.27
.6	23.3685	46.74	70.10	93.47
.7	23.4196	46.84	70.26	93.68
.8	23.4707	46.94	70.41	93.88
.9	23.5219	47.04	70.57	94.09
92.0	23.5731	47.15	70.72	94.29
.1	23.6244	47.25	70.87	94.50
.2	23.6757	47.35	71.03	94.70
.3	23.7271	47.45	71.18	94.91
.4	23.7785	47.56	71.33	95.11
.5	23.8300	47.66	71.49	95.32
.6	23.8816	47.76	71.64	95.52
.7	23.9332	47.87	71.80	95.73
.8	23.9848	47.97	71.96	95.94
.9	24.0366	48.07	72.11	96.14

Contents of Cylinders, *&c.*

DEPTH.				
5	6	7	8	9
112.80	135.35	157.91	180.47	203.03
113.05	135.65	158.26	180.87	203.48
113.30	135.96	158.62	181.28	203.94
113.55	136.26	158.97	181.68	204.39
113.80	136.56	159.32	182.08	204.84
114.05	136.86	159.67	182.48	205.29
114.31	137.17	160.03	182.89	205.75
114.56	137.47	160.38	183.29	206.20
114.81	137.77	160.73	183.70	206.66
115.07	138.08	161.09	184.10	207.12
115.32	138.38	161.44	184.50	207.57
115.57	138.68	161.80	184.91	208.03
115.83	138.99	162.16	185.32	208.49
116.08	139.30	162.51	185.73	208.94
116.33	139.60	162.86	186.13	209.39
116.59	139.90	163.22	186.54	209.85
116.84	140.21	163.58	186.94	210.31
117.10	140.51	163.93	187.35	210.77
117.36	140.83	164.30	187.77	211.24
117.61	141.13	164.65	188.18	211.70
117.87	141.44	165.01	188.58	212.16
118.12	141.74	165.37	188.99	212.62
118.38	142.05	165.73	189.40	213.08
118.64	142.36	166.09	189.82	213.54
118.89	142.67	166.45	190.22	214.00
119.15	142.98	166.81	190.64	214.47
119.41	143.29	167.17	191.05	214.93
119.67	143.60	167.53	191.46	215.40
119.93	143.91	167.90	191.88	215.87
120.18	144.22	168.25	192.29	216.32

Areas of Circles and

Diam. in Inches.	DEPTH.			
	1	2	3	4
93.0	24.0883	48.18	72.26	96.35
.1	24.1402	48.28	72.42	96.56
.2	24.1920	48.38	72.58	96.77
.3	24.2440	48.49	72.73	96.98
.4	24.2960	48.59	72.89	97.18
.5	24.3480	48.70	73.04	97.39
.6	24.4001	48.80	73.20	97.60
.7	24.4523	48.90	73.36	97.81
.8	24.5045	49.01	73.51	98.02
.9	24.5568	49.11	73.67	98.23
94.0	24.6091	49.22	73.83	98.44
.1	24.6615	49.32	73.98	98.64
.2	24.7140	49.43	74.14	98.86
.3	24.7665	49.53	74.30	99.06
.4	24.8190	49.64	74.46	99.28
.5	24.8716	49.74	74.61	99.48
.6	24.9243	49.85	74.77	99.70
.7	24.9770	49.95	74.93	99.91
.8	25.0298	50.06	75.09	100.12
.9	25.0826	50.16	75.25	100.33
95.0	25.1355	50.27	75.41	100.54
.1	25.1885	50.38	75.56	100.75
.2	25.2415	50.48	75.72	100.96
.3	25.2945	50.59	75.88	101.18
.4	25.3476	50.69	76.04	101.39
.5	25.4008	50.80	76.20	101.60
.6	25.4540	50.91	76.36	101.82
.7	25.5073	51.01	76.52	102.03
.8	25.5606	51.12	76.68	102.24
.9	25.6140	51.23	76.84	102.46

Contents of Cylinders, &c.

DEPTH.				
5	6	7	8	9
120.44	144.53	168.61	192.70	216.79
120.70	144.84	168.98	193.12	217.26
120.96	145.15	169.34	193.54	217.73
121.22	145.46	169.70	193.95	218.20
121.48	145.78	170.07	194.37	218.66
121.74	146.09	170.43	194.78	219.13
122.00	146.40	170.80	195.20	219.60
122.26	146.71	171.16	195.62	220.07
122.52	147.02	171.52	196.03	220.54
122.79	147.34	171.89	196.46	221.01
123.05	147.65	172.26	196.87	221.48
123.31	147.97	172.62	197.29	221.95
123.57	148.28	173.00	197.71	222.43
123.83	148.60	173.36	198.13	222.89
124.10	148.91	173.73	198.55	223.37
124.36	149.23	174.09	198.97	223.84
124.62	149.54	174.46	199.39	224.32
124.89	149.86	174.83	199.82	224.79
125.15	150.18	175.21	200.24	225.27
125.41	150.49	175.57	200.66	225.74
125.68	150.81	175.94	201.08	226.22
125.94	151.13	176.31	201.50	226.69
126.21	151.45	176.68	201.93	227.17
126.47	151.76	177.05	202.35	227.65
126.74	152.08	177.42	202.78	228.12
127.01	152.41	177.80	203.21	228.61
127.27	152.72	178.17	203.63	229.09
127.54	153.04	178.54	204.06	229.56
127.80	153.36	178.92	204.48	230.04
128.07	153.68	179.29	204.91	230.53

Areas of Circles and

Diam. in Inches.	DEPTH.			
	1	2	3	4
96.0	25.6675	51.33	77.00	102.67
.1	25.7210	51.44	77.16	102.88
.2	25.7745	51.55	77.32	103.10
.3	25.8282	51.66	77.48	103.31
.4	25.8818	51.76	77.65	103.53
.5	25.9355	51.87	77.81	103.74
.6	25.9893	51.98	77.97	103.96
.7	26.0432	52.09	78.13	104.17
.8	26.0971	52.19	78.29	104.39
.9	26.1510	52.30	78.45	104.60
97.0	26.2050	52.41	78.62	104.82
.1	26.2591	52.52	78.78	105.04
.2	26.3132	52.63	78.94	105.25
.3	26.3673	52.73	79.10	105.47
.4	26.4216	52.84	79.26	105.68
.5	26.4759	52.95	79.43	105.90
.6	26.5302	53.06	79.59	106.12
.7	26.5846	53.17	79.75	106.34
.8	26.6390	53.28	79.92	106.56
.9	26.6935	53.39	80.08	106.77
98.0	26.7481	53.50	80.24	106.99
.1	26.8027	53.61	80.41	107.21
.2	26.8574	53.71	80.57	107.43
.3	26.9121	53.82	80.74	107.65
.4	26.9669	53.93	80.90	107.87
.5	27.0217	54.04	81.07	108.09
.6	27.0766	54.15	81.23	108.30
.7	27.1316	54.26	81.39	108.52
.8	27.1866	54.37	81.56	108.74
.9	27.2416	54.48	81.72	108.96

Contents of Cylinders, *&c.*

DEPTH.				
5	6	7	8	9
128.34	154.00	179.67	205.34	231.00
128.61	154.33	180.05	205.77	231.49
128.87	154.64	180.42	206.19	231.97
129.14	154.97	180.80	206.62	232.45
129.41	155.29	181.17	207.06	232.94
129.68	155.61	181.55	207.48	233.42
129.95	155.93	181.92	207.91	233.90
130.22	156.26	182.30	208.34	234.39
130.49	156.58	182.68	208.78	234.87
130.76	156.91	183.06	209.21	235.36
131.03	157.23	183.44	209.64	235.85
131.30	157.55	183.81	210.07	236.33
131.57	157.88	184.19	210.50	236.82
131.84	158.20	184.57	210.94	237.30
132.11	158.53	184.95	211.37	237.79
132.38	158.86	185.33	211.81	238.28
132.65	159.18	185.71	212.24	238.77
132.92	159.50	186.09	212.67	239.26
133.20	159.83	186.47	213.11	239.75
133.46	160.16	186.85	213.54	240.24
133.74	160.49	187.24	213.98	240.73
134.02	160.82	187.62	214.42	241.23
134.29	161.14	188.00	214.86	241.71
134.56	161.47	188.38	215.30	242.21
134.84	161.80	188.77	215.74	242.70
135.11	162.13	189.15	216.18	243.20
135.38	162.46	189.53	216.61	243.68
135.66	162.79	189.92	217.05	244.18
135.93	163.12	190.30	217.49	244.67
136.21	163.45	190.69	217.93	245.17

Areas of Circles and

Diam. in Inches.	DEPTH.			
	1	2	3	4
99.0	27.2968	54.59	81.89	109.19
.1	27.3519	54.70	82.06	109.41
.2	27.4072	54.81	82.22	109.63
.3	27.4625	54.92	82.39	109.85
.4	27.5178	55.04	82.55	110.07
.5	27.5732	55.15	82.72	110.29
.6	27.6286	55.26	82.88	110.51
.7	27.6841	55.37	83.05	110.74
.8	27.7397	55.48	83.22	110.96
.9	27.7953	55.59	83.39	111.18
100.0	27.8510	55.70	83.55	111.40
.1	27.9067	55.81	83.72	111.63
.2	27.9625	55.92	83.89	111.85
.3	28.0184	56.04	84.05	112.07
.4	28.0743	56.15	84.22	112.30
.5	28.1302	56.26	84.39	112.52
.6	28.1862	56.37	84.56	112.74
.7	28.2423	56.48	84.73	112.97
.8	28.2984	56.60	84.89	113.19
.9	28.3546	56.71	85.06	113.42
101.0	28.4108	56.82	85.23	113.64
.1	28.4671	56.93	85.40	113.87
.2	28.5234	57.05	85.57	114.09
.3	28.5798	57.16	85.74	114.32
.4	28.6363	57.27	85.91	114.54
.5	28.6928	57.39	86.08	114.77
.6	28.7494	57.50	86.25	115.00
.7	28.8060	57.61	86.42	115.22
.8	28.8627	57.73	86.59	115.45
.9	28.9194	57.84	86.76	115.68

Contents of Cylinders, *&c.*

DEPTH				
5	6	7	8	9
136.49	163.78	191.08	218.38	245.67
136.76	164.11	191.46	218.82	246.17
137.04	164.44	191.85	219.26	246.66
137.31	164.77	192.23	219.70	247.16
137.59	165.11	192.63	220.14	247.66
137.87	165.44	193.01	220.58	248.16
138.14	165.77	193.40	221.02	248.65
138.42	166.10	193.79	221.47	249.16
138.70	166.44	194.18	221.92	249.66
138.98	166.77	194.57	222.36	250.16
139.26	167.11	194.96	222.81	250.66
139.54	167.44	195.35	223.26	251.16
139.81	167.77	195.73	223.70	251.66
140.09	168.11	196.13	224.14	252.16
140.37	168.44	196.52	224.59	252.67
140.65	168.78	196.91	225.04	253.17
140.93	169.12	197.30	225.49	253.67
141.21	169.45	197.69	225.94	254.18
141.49	169.79	198.09	226.38	254.68
141.77	170.12	198.48	226.83	255.19
142.06	170.47	198.88	227.29	255.70
142.34	170.80	199.27	227.74	256.20
142.62	171.14	199.66	228.18	256.71
142.90	171.48	200.06	228.64	257.22
143.18	171.82	200.45	229.09	257.72
143.47	172.16	200.85	229.54	258.24
143.75	172.49	201.24	229.99	258.74
144.03	172.84	201.64	230.45	259.25
144.32	173.18	202.04	230.90	259.77
144.60	173.51	202.43	231.35	260.27

Areas of Circles and

Diam. in Inches.	DEPTH.			
	1	2	3	4
102.0	28.9762	57.95	86.93	115.90
.1	29.0330	58.07	87.10	116.13
.2	29.0899	58.18	87.27	116.36
.3	29.1469	58.29	87.44	116.59
.4	29.2039	58.41	87.61	116.82
.5	29.2610	58.52	87.78	117.04
.6	29.3181	58.64	87.95	117.27
.7	29.3753	58.75	88.13	117.50
.8	29.4325	58.86	88.30	117.73
.9	29.4898	58.98	88.47	117.96
103.0	29.5471	59.09	88.64	118.19
.1	29.6045	59.21	88.81	118.42
.2	29.6620	59.32	88.99	118.65
.3	29.7195	59.44	89.16	118.88
.4	29.7771	59.55	89.33	119.11
.5	29.8347	59.67	89.51	119.34
.6	29.8924	59.78	89.68	119.57
.7	29.9501	59.90	89.85	119.80
.8	30.0079	60.02	90.02	120.03
.9	30.0657	60.13	90.20	120.26
104.0	30.1236	60.25	90.37	120.49
.1	30.1816	60.36	90.54	120.72
.2	30.2396	60.48	90.72	120.96
.3	30.2977	60.60	90.89	121.19
.4	30.3558	60.71	91.07	121.42
.5	30.4140	60.83	91.24	121.66
.6	30.4722	60.94	91.42	121.89
.7	30.5305	61.06	91.59	122.12
.8	30.5889	61.18	91.77	122.36
.9	30.6473	61.29	91.94	122.59

Contents of Cylinders, &c.

DEPTH.				
5	6	7	8	9
144.88	173.86	202.83	231.81	260.78
145.17	174.20	203.23	232.26	261.30
145.45	174.54	203.63	232.72	261.81
145.74	174.88	204.03	233.18	262.32
146.02	175.22	204.43	233.63	262.84
146.31	175.57	204.83	234.09	263.35
146.59	175.91	205.23	234.54	263.86
146.88	176.25	205.63	235.00	264.38
147.16	176.59	206.02	235.46	264.89
147.45	176.94	206.43	235.92	265.41
147.74	177.28	206.83	236.38	265.92
148.02	177.62	207.23	236.83	266.44
148.31	177.97	207.63	237.30	266.96
148.60	178.31	208.03	237.75	267.47
148.89	178.66	208.44	238.22	267.99
149.18	179.01	208.85	238.68	268.52
149.46	179.35	209.24	239.14	269.03
149.76	179.70	209.65	239.60	269.55
150.04	180.05	210.06	240.06	270.07
150.33	180.40	210.46	240.53	270.59
150.62	180.74	210.86	240.98	271.11
150.91	181.09	211.27	241.45	271.63
151.20	181.43	211.67	241.91	272.15
151.49	181.79	212.09	242.38	273.68
151.78	182.14	212.49	242.85	273.20
152.07	182.48	212.90	243.31	273.73
152.36	182.83	213.30	243.78	274.25
152.65	183.18	213.71	244.24	274.77
152.95	183.53	214.12	244.71	275.30
153.24	183.88	214.53	245.18	275.82

Areas of Circles and

Diam. in Inches.	DEPTH.			
	1	2	3	4
105.0	30.7057	61.41	92.12	122.82
.1	30.7642	61.53	92.29	123.06
.2	30.8228	61.65	92.47	123.29
.3	30.8814	61.76	92.64	123.52
.4	30.9401	61.88	92.82	123.76
.5	30.9989	62.00	93.00	124.00
.6	31.0577	62.12	93.17	124.23
.7	31.1165	62.23	93.35	124.46
.8	31.1754	62.35	93.53	124.70
.9	31.2344	62.47	93.70	124.94
106.0	31.2934	62.59	93.88	125.17
.1	31.3525	62.70	94.06	125.41
.2	31.4116	62.82	94.23	125.64
.3	31.4708	62.94	94.41	125.88
.4	31.5300	63.06	94.59	126.12
.5	31.5893	63.18	94.77	126.36
.6	31.6487	63.30	94.95	126.60
.7	31.7081	63.42	95.12	126.83
.8	31.7675	63.53	95.30	127.07
.9	31.8270	63.65	95.48	127.30
107.0	31.8866	63.77	95.66	127.54
.1	31.9462	63.89	95.84	127.78
.2	32.0059	64.01	96.02	128.02
.3	32.0657	64.13	96.20	128.26
.4	32.1255	64.25	96.38	128.50
.5	32.1853	64.37	96.56	128.74
.6	32.2452	64.49	96.74	128.98
.7	32.3052	64.61	96.92	129.22
.8	32.3652	64.73	97.10	129.46
.9	32.4252	64.85	97.28	129.70

Contents of Cylinders, *&c.*

DEPTH.				
5	6	7	8	9
153.53	184.24	214.94	245.65	276.35
153.82	184.58	215.35	246.11	276.88
154.12	184.94	215.76	246.58	277.41
154.41	185.29	216.17	247.05	277.93
154.70	185.64	216.58	247.52	278.46
155.00	185.99	216.99	247.99	278.99
155.29	186.35	217.41	248.46	279.52
155.58	186.70	217.81	248.93	280.04
155.88	187.05	218.23	249.40	280.58
156.17	187.40	218.64	249.87	281.11
156.47	187.76	219.05	250.34	281.64
156.76	188.11	219.46	250.82	282.17
157.06	188.47	219.88	251.29	282.70
157.36	188.83	220.30	251.77	283.24
157.65	189.18	220.71	252.24	283.77
157.95	189.53	221.12	252.71	284.30
158.25	189.89	221.54	253.19	284.84
158.54	190.25	221.96	253.66	285.37
158.84	190.60	222.37	254.14	285.90
159.14	190.96	222.79	254.62	286.44
159.43	191.32	223.20	255.09	286.97
159.73	191.68	223.62	255.57	287.51
160.03	192.04	224.04	256.05	288.05
160.33	192.40	224.46	256.53	288.59
160.63	192.75	224.88	257.00	289.13
160.93	193.11	225.30	257.48	289.67
161.23	193.47	225.72	257.96	290.21
161.53	193.83	226.14	258.44	290.75
161.83	194.19	226.56	258.92	291.29
162.13	194.55	226.98	259.40	291.83

Areas of Circles and

Diam. in Inches.	DEPTH.			
	1	2	3	4
108.0	32.4854	64.97	97.46	129.94
.1	32.5456	65.09	97.64	130.18
.2	32.6058	65.21	97.82	130.42
.3	32.6661	65.33	98.00	130.66
.4	32.7265	65.45	98.18	130.90
.5	32.7869	65.57	98.36	131.15
.6	32.8474	65.69	98.54	131.39
.7	32.9079	65.82	98.72	131.63
.8	32.9685	65.94	98.90	131.87
.9	33.0291	66.06	99.09	132.12
109.0	33.0898	66.18	99.27	132.36
.1	33.1505	66.30	99.45	132.60
.2	33.2113	66.42	99.63	132.84
.3	33.2722	66.54	99.82	133.09
.4	33.3331	66.67	100.00	133.33
.5	33.3940	66.79	100.18	133.58
.6	33.4551	66.91	100.37	133.82
.7	33.5161	67.03	100.55	134.06
.8	33.5773	67.16	100.73	134.31
.9	33.6385	67.28	100.92	134.56
110.0	33.6997	67.40	101.10	134.80
.1	33.7610	67.52	101.28	135.04
.2	33.8224	67.64	101.47	135.29
.3	33.8838	67.77	101.65	135.54
.4	33.9452	67.89	101.84	135.78
.5	34.0068	68.01	102.02	136.03
.6	34.0683	68.14	102.20	136.27
.7	34.1300	68.26	102.39	136.52
.8	34.1917	68.38	102.58	136.77
.9	34.2534	68.51	102.76	137.01

Contents of Cylinders, *&c.*

DEPTH.				
5	6	7	8	9
162.43	194.91	227.40	259.88	292.37
162.73	195.27	227.82	260.36	292.91
163.03	195.63	228.24	260.85	293.45
163.33	196.00	228.66	261.33	293.99
163.63	196.36	229.08	261.81	294.53
163.94	196.72	229.51	262.30	295.08
164.24	197.08	229.93	262.78	295.62
164.54	197.45	230.36	263.26	296.17
164.84	197.80	230.78	263.74	296.71
165.15	198.17	231.20	264.23	297.26
165.45	198.54	231.63	264.72	297.81
165.75	198.90	232.05	265.20	298.35
166.06	199.27	232.48	265.69	298.90
166.36	199.63	232.90	266.18	299.45
166.67	200.00	233.33	266.66	300.00
166.97	200.36	233.76	267.15	300.55
167.28	200.73	234.19	267.64	301.10
167.58	201.10	234.61	268.13	301.64
167.89	201.47	235.05	268.62	302.20
168.20	201.83	235.47	269.11	302.75
168.50	202.20	235.90	269.60	303.30
168.81	202.57	236.33	270.09	303.85
169.11	202.93	236.75	270.58	304.40
169.42	203.30	237.19	271.07	304.96
169.73	203.67	237.62	271.56	305.51
170.04	204.04	238.05	272.06	306.06
170.34	204.41	238.48	272.54	306.61
170.65	204.78	238.91	273.04	307.17
170.96	205.15	239.34	273.54	307.73
171.27	205.52	239.77	274.02	308.28

Areas of Circles and

Diam. in Inches.	DEPTH.			
	1	2	3	4
111.0	34.3152	68.63	102.95	137.26
.1	34.3771	68.75	103.13	137.51
.2	34.4390	68.88	103.32	137.76
.3	34.5010	69.00	103.50	138.00
.4	34.5630	69.13	103.69	138.25
.5	34.6251	69.25	103.88	138.50
.6	34.6872	69.37	104.06	138.75
.7	34.7494	69.50	104.25	139.00
.8	34.8116	69.62	104.43	139.24
.9	34.8739	69.75	104.62	139.50
112.0	34.9363	69.87	104.81	139.74
.1	34.9987	70.00	105.00	140.00
.2	35.0612	70.12	105.18	140.24
.3	35.1237	70.25	105.37	140.50
.4	35.1863	70.37	105.56	140.74
.5	35.2489	70.50	105.75	141.00
.6	35.3116	70.62	105.93	141.24
.7	35.3744	70.75	106.12	141.50
.8	35.4372	70.87	106.31	141.75
.9	35.5000	71.00	106.50	142.00
113.0	35.5629	71.13	106.69	142.25
.1	35.6259	71.25	106.88	142.50
.2	35.6889	71.38	107.07	142.76
.3	35.7520	71.50	107.26	143.01
.4	35.8152	71.63	107.45	143.26
.5	35.8784	71.76	107.64	143.51
.6	35.9416	71.88	107.82	143.76
.7	36.0049	72.01	108.02	144.02
.8	36.0683	72.14	108.21	144.27
.9	36.1317	72.26	108.40	144.53

Contents of Cylinders, *&c.*

DEPTH.				
5	6	7	8	9
171.58	205.89	240.21	274.52	308.84
171.89	206.26	240.64	275.02	309.39
172.20	206.63	241.07	275.51	309.95
172.51	207.01	241.51	276.01	310.51
172.82	207.38	241.94	276.50	311.07
173.13	207.75	242.38	277.00	311.63
173.44	208.12	242.81	277.50	312.18
173.75	208.49	243.24	277.99	312.74
174.06	208.87	243.68	278.49	313.30
174.37	209.24	244.12	278.99	313.87
174.68	209.62	244.55	279.49	314.42
175.00	209.99	244.99	279.99	314.99
175.31	210.37	245.43	280.49	315.55
175.62	210.74	245.87	280.99	316.12
175.93	211.12	246.30	281.49	316.67
176.25	211.49	246.84	281.99	317.24
176.56	211.87	247.18	282.49	317.80
176.87	212.24	247.62	282.99	318.37
177.19	212.62	248.06	283.50	318.93
177.50	213.00	248.50	284.00	319.50
177.82	213.38	248.94	284.50	320.07
178.13	213.76	249.38	285.01	320.63
178.45	214.13	249.82	285.51	321.20
178.76	214.51	250.26	286.02	321.77
179.08	214.89	250.71	286.52	322.34
179.39	215.27	251.15	287.02	322.90
179.71	215.65	251.59	287.53	323.47
180.03	216.03	252.04	288.04	324.05
180.34	216.41	252.48	288.54	324.61
180.66	216.79	252.92	289.06	325.19

Areas of Circles and

Diam. in Inches	DEPTH.			
	1	2	3	4
114.0	36.1952	72.39	108.59	144.78
.1	36.2587	72.52	108.78	145.04
.2	36.3223	72.64	108.97	145.29
.3	36.3859	72.77	109.16	145.54
.4	36.4496	72.90	109.35	145.80
.5	36.5134	73.03	109.54	146.05
.6	36.5772	73.15	109.73	146.31
.7	36.6410	73.28	109.92	146.56
.8	36.7049	73.41	110.12	146.82
.9	36.7689	73.54	110.31	147.08
115.0	36.8329	73.67	110.50	147.33
.1	36.8970	73.79	110.69	147.59
.2	36.9612	73.92	110.88	147.84
.3	37.0254	74.05	111.08	148.10
.4	37.0896	74.18	111.27	148.36
.5	37.1539	74.31	111.46	148.62
.6	37.2183	74.44	111.66	148.87
.7	37.2827	74.57	111.85	149.13
.8	37.3472	74.69	112.04	149.39
.9	37.4117	74.82	112.24	149.65
116.0	37.4763	74.95	112.43	149.91
.1	37.5409	75.08	112.62	150.16
.2	37.6056	75.21	112.82	150.42
.3	37.6704	75.34	113.01	150.68
.4	37.7352	75.47	113.21	150.94
.5	37.8001	75.60	113.40	151.20
.6	37.8650	75.73	113.60	151.46
.7	37.9300	75.86	113.79	151.72
.8	37.9950	75.99	113.99	151.98
.9	38.0601	76.12	114.18	152.24

Contents of Cylinders, *&c.*

DEPTH.				
5	6	7	8	9
180.98	217.17	253.36	289.56	325.76
181.30	217.55	253.81	290.07	326.33
181.61	217.93	254.25	290.58	326.90
181.93	218.32	254.70	291.09	327.47
182.25	218.69	255.14	291.59	328.04
182.57	219.08	255.59	292.10	328.62
182.89	219.46	256.04	292.62	329.19
183.21	219.85	256.49	293.13	329.77
183.53	220.23	256.94	293.64	330.35
183.85	220.61	257.38	294.15	330.92
184.17	221.00	257.83	294.66	331.50
184.49	221.38	258.28	295.18	332.07
184.81	221.77	258.73	295.69	332.65
185.13	222.15	259.18	296.20	333.23
185.45	222.53	259.62	296.71	333.80
185.78	222.92	260.08	297.23	334.39
186.09	223.31	260.53	297.74	334.96
186.42	223.70	260.98	298.27	335.55
186.74	224.08	261.43	298.78	336.12
187.06	224.47	261.88	299.30	336.71
187.38	224.86	262.33	299.81	337.29
187.71	225.25	262.79	300.33	337.87
188.03	225.63	263.24	300.84	338.45
188.35	226.02	263.69	301.36	339.03
188.68	226.41	264.15	301.88	339.62
189.00	226.80	264.60	302.40	340.20
189.33	227.19	265.06	302.92	340.79
189.65	227.58	265.51	303.44	341.37
189.98	227.97	265.97	303.96	341.96
190.30	228.36	266.42	304.48	342.54

Areas of Circles and

Diam. in Inches.	DEPTH.			
	1	2	3	4
117.0	38.1252	76.25	114.38	152.50
.1	38.1904	76.38	114.57	152.76
.2	38.2557	76.51	114.77	153.02
.3	38.3210	76.64	114.96	153.28
.4	38.3864	76.77	115.16	153.54
.5	38.4518	76.90	115.36	153.81
.6	38.5173	77.03	115.55	154.07
.7	38.5828	77.17	115.75	154.33
.8	38.6484	77.30	115.95	154.59
.9	38.7140	77.43	116.14	154.86
118.0	38.7797	77.56	116.34	155.12
.1	38.8455	77.69	116.54	155.38
.2	38.9113	77.82	116.73	155.64
.3	38.9772	77.95	116.93	155.91
.4	39.0431	78.09	117.13	156.17
.5	39.1091	78.22	117.33	156.44
.6	39.1751	78.35	117.53	156.70
.7	39.2412	78.48	117.72	156.96
.8	39.3073	78.61	117.92	157.23
.9	39.3735	78.75	118.12	157.49
119.0	39.4398	78.88	118.32	157.76
.1	39.5061	79.01	118.52	158.02
.2	39.5725	79.14	118.72	158.29
.3	39.6389	79.28	118.92	158.56
.4	39.7054	79.41	119.12	158.82
.5	39.7719	79.54	119.32	159.09
.6	39.8385	79.68	119.51	159.35
.7	39.9052	79.81	119.72	159.62
.8	39.9719	79.94	119.92	159.89
.9	40.0386	80.08	120.11	160.15

Contents of Cylinders, &c.

DEPTH				
5	6	7	8	9
190.63	228.75	266.88	305.00	343.13
190.95	229.14	267.33	305.52	343.71
191.28	229.54	267.79	306.05	344.30
191.61	229.93	268.25	306.57	344.89
191.93	230.32	268.70	307.09	345.47
192.26	230.71	269.16	307.62	346.07
192.59	231.10	269.62	308.14	346.65
192.92	231.50	270.08	308.66	347.25
193.24	231.89	270.54	309.18	347.83
193.57	232.28	271.00	309.71	348.43
193.90	232.68	271.46	310.24	349.02
194.23	233.07	271.92	310.76	349.61
194.56	233.47	272.38	311.29	350.20
194.89	233.86	272.84	311.82	350.79
195.22	234.26	273.30	312.34	351.39
195.55	234.65	273.76	312.87	351.98
195.88	235.06	274.23	313.40	352.58
196.21	235.45	274.69	313.93	353.17
196.54	235.84	275.15	314.46	353.76
196.87	236.24	275.61	314.98	354.36
197.20	236.64	276.08	315.52	354.96
197.53	237.04	276.54	316.05	355.55
197.86	237.43	277.01	316.58	356.15
198.20	237.83	277.47	317.11	356.75
198.53	238.23	277.94	317.64	357.35
198.86	238.63	278.40	318.18	357.95
199.19	239.03	278.87	318.70	358.54
199.53	239.43	279.34	319.24	359.15
199.86	239.83	279.80	319.78	359.75
200.19	240.23	280.27	320.30	360.34

Areas of Circles and

Diam. in Inches.	DEPTH.			
	1	2	3	4
120.0	40.1054	80.21	120.32	160.42
.1	40.1723	80.34	120.52	160.69
.2	40.2392	80.48	120.72	160.96
.3	40.3062	80.61	120.92	161.22
.4	40.3733	80.75	121.12	161.49
.5	40.4403	80.88	121.32	161.76
.6	40.5075	81.01	121.52	162.03
.7	40.5747	81.15	121.73	162.30
.8	40.6420	81.28	121.93	162.57
.9	40.7093	81.42	122.13	162.84
121.0	40.7766	81.55	122.33	163.10
.1	40.8441	81.69	122.53	163.38
.2	40.9116	81.82	122.74	163.64
.3	40.9791	81.96	122.94	163.92
.4	41.0467	82.09	123.14	164.19
.5	41.1143	82.23	123.34	164.46
.6	41.1820	82.36	123.55	164.73
.7	41.2498	82.50	123.75	165.00
.8	41.3176	82.63	123.95	165.27
.9	41.3855	82.77	124.16	165.54
122.0	41.4534	82.91	124.36	165.81
.1	41.5214	83.04	124.56	166.08
.2	41.5895	83.18	124.77	166.36
.3	41.6575	83.31	124.97	166.63
.4	41.7257	83.45	125.18	166.90
.5	41.7939	83.59	125.38	167.18
.6	41.8622	83.72	125.59	167.45
.7	41.9305	83.86	125.79	167.72
.8	41.9989	84.00	126.00	168.00
.9	42.0673	84.13	126.20	168.27

Contents of Cylinders, &c.

DEPTH.				
5	6	7	8	9
200.53	240.63	280.74	320.84	360.95
200.86	241.03	281.20	321.38	361.55
201.20	241.43	281.67	321.91	362.15
201.53	241.84	282.14	322.45	362.75
201.87	242.24	282.61	322.98	363.36
202.20	242.64	283.08	323.52	363.96
202.54	243.04	283.55	324.06	364.56
202.88	243.45	284.02	324.60	365.18
203.21	243.85	284.49	325.14	365.78
203.55	244.25	284.96	325.67	366.38
203.88	244.66	285.43	326.21	366.98
204.22	245.06	285.91	326.75	367.60
204.56	245.47	286.38	327.30	368.21
204.90	245.87	286.85	327.83	368.81
205.24	246.28	287.33	328.38	369.42
205.57	246.68	287.80	328.91	370.03
205.91	247.09	288.27	329.46	370.64
206.25	247.50	288.75	330.00	371.25
206.59	247.90	289.22	330.54	371.85
206.93	248.31	289.70	331.08	372.47
207.27	248.72	290.17	331.62	373.08
207.61	249.13	290.65	332.17	373.69
207.95	249.53	291.12	332.71	374.30
208.29	249.94	291.60	333.26	374.91
208.63	250.36	292.08	333.81	375.53
208.97	250.76	292.56	334.35	376.15
209.31	251.17	293.03	334.90	376.76
209.65	251.58	293.51	335.44	377.37
210.00	251.99	293.99	335.99	377.99
210.34	252.40	294.47	336.54	378.60

Areas of Circles and

Diam. in Inches.	DEPTH.			
	1	2	3	4
123.0	42.1358	84.27	126.41	168.55
.1	42.2043	84.41	126.61	168.82
.2	42.2729	84.55	126.82	169.09
.3	42.3416	84.68	127.02	169.36
.4	42.4103	84.82	127.23	169.64
.5	42.4790	84.96	127.44	169.92
.6	42.5479	85.10	127.64	170.19
.7	42.6167	85.23	127.85	170.47
.8	42.6857	85.37	128.06	170.74
.9	42.7547	85.51	128.27	171.02
124.0	42.8237	85.65	128.47	171.29
.1	42.8928	85.79	128.68	171.57
.2	42.9619	85.92	128.89	171.85
.3	43.0312	86.06	129.09	172.12
.4	43.1004	86.20	129.30	172.40
.5	43.1697	86.34	129.51	172.68
.6	43.2391	86.48	129.72	172.96
.7	43.3086	86.62	129.92	173.23
.8	43.3780	86.76	130.13	173.51
.9	43.4476	86.89	130.34	173.79
125.0	43.5172	87.03	130.55	174.07
.1	43.5868	87.17	130.76	174.35
.2	43.6566	87.31	130.97	174.62
.3	43.7263	87.45	131.18	174.90
.4	43.7961	87.59	131.39	175.18
.5	43.8660	87.73	131.60	175.46
.6	43.9360	87.87	131.81	175.74
.7	44.0059	88.01	132.02	176.02
.8	44.0760	88.15	132.23	176.30
.9	44.1461	88.29	132.44	176.58

Contents of Cylinders, *&c.*

DEPTH.				
5	6	7	8	9
210.68	252.82	294.95	337.09	379.22
211.02	253.22	295.43	337.63	379.84
211.37	253.64	295.91	338.18	380.46
211.71	254.05	296.39	338.73	381.07
212.05	254.46	296.87	339.28	381.69
212.40	254.87	297.35	339.83	382.31
212.74	255.29	297.84	340.38	382.93
213.09	255.70	298.32	340.94	383.55
213.43	256.12	298.80	341.49	384.17
213.78	256.53	299.29	342.04	384.80
214.12	256.94	299.76	342.58	385.41
214.47	257.36	300.25	343.14	386.04
214.81	257.77	300.73	343.70	386.66
215.16	258.19	301.22	344.25	387.28
215.50	258.60	301.70	344.80	387.90
215.85	259.02	302.19	345.36	388.53
216.20	259.43	302.67	345.91	389.15
216.54	259.85	303.16	346.46	389.77
216.89	260.27	303.65	347.02	390.40
217.24	260.68	304.13	347.58	391.02
217.59	261.10	304.62	348.14	391.65
217.94	261.52	305.11	348.70	392.28
218.28	261.94	305.59	349.25	392.90
218.63	262.36	306.08	349.81	393.53
218.98	262.78	306.57	350.37	394.16
219.33	263.20	307.06	350.93	394.79
219.68	263.62	307.55	351.49	395.42
220.03	264.04	308.04	352.05	396.05
220.38	264.46	308.53	352.61	396.68
220.73	264.88	309.02	353.17	397.31

Areas of Circles and

Diam. in Inches.	DEPTH.			
	1	2	3	4
126.0	44.2162	88.43	132.65	176.86
.1	44.2865	88.57	132.86	177.14
.2	44.3567	88.71	133.07	177.43
.3	44.4271	88.85	133.28	177.71
.4	44.4974	88.99	133.49	177.99
.5	44.5679	89.14	133.70	178.27
.6	44.6384	89.28	133.91	178.55
.7	44.7089	89.42	134.13	178.84
.8	44.7795	89.56	134.34	179.12
.9	44.8502	89.70	134.55	179.40
127.0	44.9209	89.84	134.76	179.68
.1	44.9916	89.98	134.98	179.97
.2	45.0625	90.12	135.19	180.25
.3.	45.1334	90.27	135.40	180.53
.4	45.2043	90.41	135.61	180.82
.5	45.2753	90.55	135.83	181.10
.6	45.3463	90.69	136.04	181.38
.7	45.4174	90.83	136.25	181.67
.8	45.4886	90.98	136.46	181.95
.9	45.5598	91.12	136.68	182.24
128.0	45.6311	91.26	136.89	182.52
.1	45.7024	91.40	137.11	182.81
.2	45.7738	91.55	137.32	183.10
.3	45.8452	91.69	137.54	183.38
.4	45.9167	91.83	137.75	183.67
.5	45.9883	91.98	137.96	183.45
.6	46.0599	92.12	138.18	184.24
.7	46.1315	92.26	138.39	184.52
.8	46.2032	92.41	138.61	184.81
.9	46.2750	92.55	138.83	185.10

Contents of Cylinders, &c.

DEPTH.				
5	6	7	8	9
221.08	265.30	309.51	353.73	397.94
221.43	265.72	310.00	354.29	398.57
221.79	266.14	310.50	354.86	399.21
222.14	266.56	310.99	355.42	399.84
222.49	266.98	311.48	355.98	400.47
222.84	267.41	311.98	356.54	401.11
223.19	267.83	312.47	357.10	401.74
223.55	268.25	312.96	357.67	402.38
223.90	268.67	313.45	358.23	403.01
224.25	269.10	313.95	358.80	403.65
224.61	269.53	314.45	359.37	404.29
224.96	269.95	314.94	359.94	404.93
225.31	270.37	315.43	360.50	405.56
225.67	270.80	315.93	361.06	406.20
226.02	271.22	316.43	361.63	406.84
226.38	271.65	316.93	362.20	407.48
226.73	272.08	317.42	362.77	408.11
227.09	272.50	317.92	363.34	408.75
227.44	272.93	318.42	363.90	409.39
227.80	273.36	318.92	364.48	410.04
228.16	273.79	319.42	365.05	410.68
228.51	274.21	319.91	365.62	411.32
228.87	274.64	320.42	366.19	411.97
229.23	275.07	320.92	366.77	412.61
229.58	275.50	321.42	367.34	413.25
229.94	275.93	321.92	367.90	413.89
230.30	276.36	322.42	368.48	414.54
230.66	276.79	322.92	369.05	415.18
231.02	277.22	323.42	369.62	415.83
231.38	277.65	323.93	370.20	416.48

Areas of Circles and

Diam. in Inches.	DEPTH.			
	1	2	3	4
129.0	46.3468	92.69	139.04	185.39
.1	46.4187	92.84	139.26	185.68
.2	46.4907	92.98	139.47	185.96
.3	46.5627	93.13	139.69	186.25
.4	46.6347	93.27	139.91	186.54
.5	46.7068	93.41	140.12	186.83
.6	46.7790	93.56	140.34	187.12
.7	46.8512	93.70	140.55	187.40
.8	46.9235	93.85	140.77	187.69
.9	46.9958	93.99	140.99	187.98
130.0	47.0682	94.14	141.20	188.27
.1	47.1406	94.28	141.42	188.56
.2	47.2131	94.43	141.64	188.85
.3	47.2857	94.57	141.86	189.14
.4	47.3583	94.72	142.07	189.43
.5	47.4309	94.86	142.29	189.72
.6	47.5037	95.01	142.51	190.02
.7	47.5764	95.15	142.73	190.30
.8	47.6493	95.30	142.95	190.60
.9	47.7222	95.44	143.17	190.89
131.0	47.7951	95.59	143.39	191.18
.1	47.8681	95.74	143.60	191.47
.2	47.9412	95.88	143.82	191.76
.3	48.0143	96.03	144.04	192.06
.4	48.0874	96.17	144.26	192.35
.5	48.1606	96.32	144.48	192.64
.6	48.2339	96.47	144.70	192.94
.7	48.3073	96.61	144.92	193.23
.8	48.3806	96.76	145.14	193.52
.9	48.4541	96.91	145.36	193.82

Contents of Cylinders, *&c.*

DEPTH.				
5	6	7	8	9
231.74	278.08	324.43	370.78	417.12
232.10	278.51	324.93	371.35	417.77
232.46	278.95	325.44	371.93	418.42
232.82	279.38	325.94	372.50	419.07
233.18	279.81	326.45	373.08	419.72
233.54	280.24	326.95	373.66	420.36
233.90	280.67	327.45	374.23	421.01
234.26	281.11	327.96	374.81	421.66
234.62	281.54	328.46	375.38	422.31
234.98	281.98	328.97	375.97	422.95
235.34	282.41	329.48	376.54	423.61
235.70	282.84	329.98	377.12	424.26
236.07	283.28	330.49	377.70	424.92
236.43	283.72	331.00	378.29	425.57
236.79	284.15	331.51	378.86	426.22
237.16	284.59	332.02	379.45	426.88
237.52	285.02	332.53	380.03	427.54
237.88	285.46	333.03	380.61	428.18
238.25	285.89	333.54	381.19	428.84
238.61	286.33	334.05	381.78	429.50
238.98	286.77	334.57	382.36	430.16
239.34	287.21	335.08	382.94	430.81
239.71	287.65	335.59	383.53	431.47
240.07	288.08	336.10	384.11	432.13
240.44	288.52	336.61	384.70	432.78
240.80	288.96	337.12	385.28	433.44
241.17	289.40	337.64	385.87	434.11
241.54	289.84	338.15	386.46	434.76
241.90	290.28	338.66	387.04	435.42
242.27	290.72	339.18	387.63	436.09

Areas of Circles and

Diam. in Inches	DEPTH.			
	1	2	3	4
132.0	48.5276	97.05	145.58	194.11
.1	48.6011	97.20	145.80	194.40
.2	48.6747	97.35	146.03	194.70
.3	48.7484	97.50	146.24	194.99
.4	48.8221	97.64	146.47	195.29
.5	48.8959	97.79	146.69	195.58
.6	48.9697	97.94	146.91	195.88
.7	49.0436	98.09	147.13	196.17
.8	49.1176	98.23	147.35	196.47
.9	49.1916	98.38	147.57	196.76
133.0	49.2656	98.53	147.80	197.06
.1	49.3397	98.68	148.02	197.36
.2	49.4139	98.83	148.24	197.66
.3	49.4881	98.98	148.46	197.95
.4	49.5624	99.12	148.69	198.25
.5	49.6367	99.27	148.91	198.55
.6	49.7111	99.42	149.13	198.84
.7	49.7856	99.57	149.36	199.14
.8	49.8601	99.72	149.58	199.44
.9	49.9346	99.87	149.80	199.74
134.0	50.0093	100.02	150.03	200.04
.1	50.0839	100.17	150.25	200.34
.2	50.1586	100.32	150.47	200.63
.3	50.2334	100.47	150.70	200.93
.4	50.3083	100.62	150.92	201.23
.5	50.3832	100.77	151.15	201.53
.6	50.4581	100.92	151.37	201.83
.7	50.5331	101.07	151.60	202.13
.8	50.6082	101.22	151.82	202.43
.9	50.6833	101.37	152.05	202.73

Contents of Cylinders, *&c.*

DEPTH				
5	6	7	8	9
242.64	291.16	339.69	388.22	436.74
243.01	291.61	340.21	388.81	437.41
243.38	292.05	340.73	389.40	438.08
243.74	292.49	341.24	389.98	438.73
244.11	292.93	341.75	390.58	439.40
244.48	293.38	342.27	391.17	440.06
244.85	293.82	342.79	391.76	440.73
245.22	294.26	343.30	392.34	441.39
245.59	294.70	343.82	392.94	442.05
245.96	295.15	344.34	393.53	442.72
246.33	295.59	344.86	394.12	443.39
246.70	296.04	345.38	394.72	444.06
247.07	296.48	345.90	395.31	444.73
247.44	296.93	346.42	395.90	445.39
247.81	297.37	346.93	396.50	446.06
248.19	297.82	347.46	397.10	446.73
248.56	298.27	347.98	397.69	447.40
248.93	298.71	348.50	398.28	448.07
249.30	299.16	349.02	398.88	448.74
249.67	299.60	349.54	399.47	449.41
250.05	300.05	350.06	400.07	450.08
250.42	300.50	350.59	400.67	450.76
250.79	300.95	351.11	401.26	451.42
251.17	301.40	351.63	401.86	452.10
251.54	301.85	352.16	402.46	452.77
251.92	302.30	352.68	403.06	453.45
252.29	302.75	353.21	403.66	454.12
252.67	303.20	353.73	404.26	454.80
253.04	303.65	354.26	404.86	455.47
253.42	304.10	354.78	405.46	456.15

Areas of Circles and

Diam. in Inches.	DEPTH.			
	1	2	3	4
135.0	50.7584	101.52	152.27	203.03
.1	50.8340	101.67	152.50	203.34
.2	50.9090	101.82	152.73	203.64
.3	50.9842	101.97	152.95	203.94
.4	51.0600	102.12	153.18	204.24
.5	51.1351	102.27	153.41	204.54
.6	51.2110	102.42	153.63	204.84
.7	51.2861	102.57	153.86	205.14
.8	51.3620	102.72	154.09	205.45
.9	51.4374	102.87	154.31	205.75
136.0	51.5132	103.03	154.54	206.05
.1	51.5890	103.18	154.77	206.36
.2	51.6650	103.33	155.00	206.66
.3	51.7410	103.48	155.22	206.96
.4	51.8170	103.63	155.45	207.27
.5	51.8930	103.79	155.68	207.57
.6	51.9690	103.94	155.91	207.88
.7	52.0450	104.09	156.14	208.18
.8	52.1210	104.24	156.36	208.48
.9	52.1972	104.39	156.59	208.79
137.0	52.2740	104.55	156.82	209.10
.1	52.3500	104.70	157.05	209.40
.2	52.4262	104.85	157.28	209.70
.3	52.5030	105.01	157.51	210.01
.4	52.5792	105.16	157.74	210.32
.5	52.6560	105.31	157.97	210.62
.6	52.7324	105.46	158.20	210.93
.7	52.8090	105.62	158.43	211.24
.8	52.8860	105.77	158.66	211.54
.9	52.9630	105.93	158.89	211.85

Contents of Cylinders, *&c.*

DEPTH				
5	6	7	8	9
253.79	304 55	355.31	406.06	456.82
254.17	305.00	355.84	406.67	457.51
254.55	305.45	356.36	407.27	458.18
254.92	305.90	356.89	407.87	458.86
255.30	306.36	357 42	408.48	459.54
255.68	306.81	357.94	409.08	460.22
256.06	307.27	358.48	409.69	460.90
256.43	307.72	359.00	410.29	461.57
256.81	308.17	359.53	410.90	462.26
257.19	308.62	360.06	411.50	462.93
257.57	309.08	360.59	412.10	463 62
257.95	309.53	361.12	412.71	464.30
258.33	309.99	361.66	413.32	464 99
258.71	310.45	362.19	413.93	465 67
259.09	310.90	362.72	414.54	466.35
259.47	311.36	363.25	415.14	467.04
259.85	311.81	363.78	415.75	467.72
260.23	312 27	364.32	416.36	468.41
260.61	312.73	364.85	416 97	469.09
260 99	313.18	365.38	417.58	469.77
261.37	313.64	365 92	418.19	470 47
261.75	314.10	366.45	418.80	471.15
262.13	314.56	366.98	419.41	471.83
262.52	315.02	367.52	420 02	472.53
262.90	315.47	368.05	420.63	473.21
263.28	315.94	368.59	421.25	473.90
263.66	316.39	369.12	421.86	474.59
264.05	316.85	369.66	422.47	475.28
264.43	317.32	370.20	423.09	475.97
264 82	317.78	370.74	423.70	476 67

Areas of Circles and

Diam. in Inches.	DEPTH.			
	1	2	3	4
138.0	53.0394	106.08	159.12	212.16
.1	53.1164	106.23	159.35	212.46
.2	53.1933	106.39	159.58	212.77
.3	53.2703	106.54	159.81	213.08
.4	53.3474	106.69	160.04	213.39
.5	53.4245	106.85	160.27	213.70
.6	53.5017	107.00	160.51	214.01
.7	53.5789	107.16	160.74	214.32
.8	53.6562	107.31	160.97	214.62
.9	53.7335	107.47	161.20	214.93
139.0	53.8109	107.62	161.43	215.24
.1	53.8884	107.78	161.66	215.55
.2	53.9659	107.93	161.90	215.86
.3	54.0434	108.09	162.13	216.17
.4	54.1211	108.24	162.36	216.48
.5	54.1987	108.40	162.60	216.80
.6	54.2765	108.55	162.83	217.10
.7	54.3543	108.71	163.06	217.42
.8	54.4321	108.86	163.30	217.73
.9	54.5100	109.02	163.53	218.04
140.0	54.5880	109.18	163.76	218.35
.1	54.6660	109.33	164.00	218.66
.2	54.7440	109.49	164.23	218.98
.3	54.8222	109.64	164.47	219.29
.4	54.9003	109.80	164.70	219.60
.5	54.9786	109.96	164.93	219.91
.6	55.0569	110.11	165.17	220.23
.7	55.1352	110.27	165.41	220.54
.8	55.2136	110.43	165.64	220.85
.9	55.2921	110.58	165.88	221.17

Contents of Cylinders, &c.

DEPTH.				
5	6	7	8	9
265.20	318.23	371.27	424.31	477.35
265.58	318.70	371.81	424.93	478.04
265.97	319.16	372.35	425.54	478.74
266.35	319.62	372.89	426.16	479.43
266.74	320.08	373.43	426.78	480.12
267.12	320.54	373.97	427.39	480.82
267.51	321.01	374.51	428.02	481.52
267.90	321.47	375.05	428.63	482.21
268.28	321.94	375.59	429.25	482.90
268.67	322.40	376.13	429.86	483.60
269.06	322.87	376.68	430.49	484.30
269.44	323.33	377.22	431.10	484.99
269.83	323.80	377.76	431.73	485.69
270.22	324.26	378.30	432.34	486.39
270.61	324.73	378.85	432.97	487.09
271.00	325.19	379.39	433.59	487.79
271.38	325.66	379.93	434.21	488.48
271.77	326.12	380.48	434.83	489.19
272.16	326.59	381.02	435.46	489.89
272.55	327.06	381.57	436.08	490.59
272.94	327.53	382.12	436.70	491.29
273.33	328.00	382.66	437.33	491.99
273.72	328.46	383.21	437.95	492.70
274.11	328.93	383.75	438.58	493.40
274.50	329 40	384.30	439.20	494.10
274.89	329.87	384.85	439.82	494.80
275.29	330.34	385.40	440.46	495.51
275.68	330.81	385.95	441.08	496.22
276.07	331.28	386.49	441.70	496.92
276.46	331.75	387.04	442.34	497.63

Areas of Circles and

Diam. in Inches.	DEPTH.			
	1	2	3	4
141.0	55.3706	110.74	166.11	221.48
.1	55.4491	110.90	166.35	221.80
.2	55.5278	111.06	166.58	222.11
.3	55.6064	111.21	166.82	222.42
.4	55.6852	111.37	167.06	222.74
.5	55.7640	111.53	167.29	223.06
.6	55.8428	111.69	167.53	223.37
.7	55.9217	111.84	167.77	223.69
.8	56.0007	112.00	168.00	224.00
.9	56.0797	112.16	168.24	224.32
142.0	56.1587	112.32	168.48	224.64
.1	56.2379	112.48	168.71	224.95
.2	56.3170	112.63	168.95	225.27
.3	56.3963	112.79	169.19	225.58
.4	56.4756	112.95	169.43	225.90
.5	56.5549	113.11	169.67	226.22
.6	56.6343	113.27	169.90	226.54
.7	56.7138	113.43	170.14	226.86
.8	56.7933	113.59	170.38	227.17
.9	56.8729	113.75	170.62	227.49
143.0	56.9525	113.90	170.86	227.81
.1	57.0322	114.06	171.10	228.13
.2	57.1119	114.22	171.34	228.45
.3	57.1917	114.38	171.58	228.77
.4	57.2716	114.54	171.81	229.08
.5	57.3515	114.70	172.05	229.40
.6	57.4314	114.86	172.29	229.72
.7	57.5114	115.02	172.53	230.04
.8	57.5915	115.18	172.77	230.36
.9	57.6716	115.34	173.01	230.68

Contents of Cylinders, *&c.*

DEPTH.				
5	6	7	8	9
276.85	332.22	387.59	442.96	498.33
277.25	332.69	388.14	443.59	499.04
277.64	333.17	388.70	444.22	499.75
278.03	333.64	389.24	444.85	500.45
278.43	334.11	389.80	445.48	501.17
278.82	334.58	390.35	446.11	501.88
279.22	335.06	390.90	446.74	502.59
279.61	335.53	391.45	447.38	503.30
280.01	336.01	392.01	448.01	504.01
280.40	336.48	392.56	448.64	504.72
280.80	336.95	393.11	449.27	505.43
281.19	337.43	393.67	449.90	506.14
281.59	337.90	394.22	450.54	506.85
281.98	338.38	394.77	451.17	507.56
282.38	338.85	395.33	451.80	508.28
282.78	339.33	395.89	452.44	509.00
283.17	339.80	396.44	453.07	509.71
283.57	340.28	397.00	453.71	510.43
283.97	340.76	397.55	454.34	511.14
284.37	341.24	398.11	454.98	511.86
284.76	341.71	398.66	455.62	512.57
285.16	342.19	399.22	456.26	513.29
285.56	342.67	399.78	456.90	514.01
285.96	343.15	400.34	457.54	514.73
286.36	343.63	400.90	458.17	515.44
286.76	344.11	401.46	458.81	516.16
287.16	344.59	402.02	459.45	516.88
287.56	345.07	402.58	460.09	517.60
287.96	345.55	403.14	460.73	518.32
288.36	346.03	403.70	461.37	519.04

Areas of Circles and

Diam. in Inches.	DEPTH.			
	1	2	3	4
144.0	57.7518	115.50	173.26	231.01
.1	57.8321	115.66	173.50	231.33
.2	57.9124	115.82	173.74	231.65
.3	57.9927	115.99	173.98	231.97
.4	58.0731	116.15	174.22	232.29
.5	58.1536	116.31	174.46	232.61
.6	58.2341	116.47	174.70	232.94
.7	58.3147	116.63	174.95	233.26
.8	58.3953	116.79	175.19	233.58
.9	58.4760	116.95	175.43	233.90
145.0	58.5567	117.11	175.67	234.23
.1	58.6375	117.27	175.91	234.55
.2	58.7184	117.44	176.15	234.87
.3	58.7993	117.60	176.40	235.20
.4	58.8802	117.76	176.64	235.52
.5	58.9613	117.92	176.88	235.84
.6	59.0423	118.08	177.13	236.17
.7	59.1235	118.25	177.37	236.49
.8	59.2047	118.41	177.62	236.82
.9	59.2859	118.57	177.86	237.14
146.0	59.3672	118.73	178.10	237.47
.1	59.4485	118.90	178.34	237.79
.2	59.5299	119.06	178.59	238.12
.3	59.6114	119.22	178.83	238.44
.4	59.6929	119.39	179.08	238.77
.5	59.7745	119.55	179.32	239.10
.6	59.8561	119.71	179.57	239.42
.7	59.9378	119.88	179.81	239.75
.8	60.0196	120.04	180.06	240.08
.9	60.1014	120.20	180.30	240.40

Contents of Cylinders, &c.

DEPTH.				
5	6	7	8	9
288.76	346.51	404.26	462.02	519.77
289.16	346.99	404.82	462.66	520.49
289.56	347.47	405.38	463.30	521.21
289.97	347.96	405.95	463.94	521.94
290.37	348.44	406.51	464.58	522.66
290.77	348.92	407.07	465.22	523.38
291.17	349.40	407.64	465.87	524.11
291.58	349.89	408.21	466.52	524.84
291.98	350.37	408.77	467.16	525.56
292.38	350.86	409.33	467.81	526.28
292.79	351.34	409.90	468.46	527.01
293.19	351.82	410.46	469.10	527.73
293.59	352.31	411.03	469.74	528.46
294.00	352.79	411.59	470.39	529.19
294.40	353.28	412.16	471.04	529.92
294.81	353.77	412.73	471.69	530.65
295.21	354.25	413.29	472.34	531.38
295.62	354.74	413.86	472.98	532.11
296.03	355.23	414.44	473.64	532.85
296.43	355.72	415.00	474.29	533.57
296.84	356.20	415.57	474.94	534.30
297.24	356.69	416.14	475.58	535.03
297.65	357.18	416.71	476.24	535.77
298.06	357.67	417.28	476.89	536.50
298.47	358.16	417.85	477.54	537.24
298.87	358.64	418.42	478.19	537.97
299.28	359.14	418.99	478.85	538.70
299.69	359.63	419.57	479.50	539.44
300.10	360.11	420.13	480.15	540.17
300.51	360.61	420.71	480.81	540.91

Areas of Circles and

Diam. in Inches.	DEPTH.			
	1	2	3	4
147.0	60.1832	120.37	180.55	240.73
.1	60.2651	120.53	180.80	241.06
.2	60.3471	120.69	181.04	241.39
.3	60.4291	120.86	181.29	241.72
.4	60.5112	121.02	181.53	242.04
.5	60.5933	121.19	181.78	242.37
.6	60.6755	121.35	182.03	242.70
.7	60.7578	121.51	182.27	243.03
.8	60.8401	121.68	182.52	243.36
.9	60.9224	121.84	182.77	243.69
148.0	61.0048	122.01	183.01	244.02
.1	61.0873	122.17	183.26	244.35
.2	61.1698	122.34	183.51	244.68
.3	61.2524	122.50	183.76	245.01
.4	61.3350	122.67	184.01	245.34
.5	61.4177	122.83	184.25	245.67
.6	61.5005	123.00	184.50	246.00
.7	61.5833	123.17	184.75	246.33
.8	61.6661	123.33	185.00	246.66
.9	61.7490	123.50	185.25	247.00
149.0	61.8320	123.66	185.50	247.33
.1	61.9150	123.83	185.75	247.66
.2	61.9981	124.00	185.99	247.99
.3	62.0812	124.16	186.24	248.32
.4	62.1644	124.33	186.49	248.66
.5	62.2477	124.49	186.74	248.99
.6	62.3310	124.66	186.99	249.32
.7	62.4143	124.83	187.24	249.66
.8	62.4978	124.99	187.49	249.99
.9	62.5812	125.16	187.74	250.32

Contents of Cylinders, *&c.*

DEPTH.				
5	6	7	8	9
300.92	361.10	421.28	481.46	541.65
301.33	361.59	421.86	482.12	542.39
301.74	362.08	422.43	482.78	543.12
302.15	362.57	423.00	483.43	543.86
302.56	363.07	423.58	484.09	544.60
302.96	363.56	424.15	484.74	545.34
303.38	364.05	424.73	485.40	546.08
303.79	364.54	425.30	486.06	546.81
304.20	365.04	425.88	486.72	547.56
304.61	365.53	426.45	487.38	548.30
305.02	366.02	427.03	488.03	549.04
305.44	366.52	427.61	488.70	549.78
305.85	367.01	428.18	489.35	550.52
306.26	367.51	428.76	490.02	551.26
306.68	368.01	429.35	490.68	552.02
307.09	368.50	429.92	491.34	552.75
307.50	369.00	430.50	492.00	553.50
307.92	369.50	431.08	492.66	554.25
308.33	370.00	431.66	493.33	554.99
308.75	370.49	432.24	493.99	555.74
309.16	370.99	432.82	494.66	556.49
309.58	371.49	433.41	495.32	557.24
309.99	371.99	433.99	495.98	557.98
310.41	372.49	434.57	496.65	558.73
310.82	372.98	435.15	497.31	559.48
311.24	373.48	435.73	497.98	560.22
311.66	373.99	436.32	498.65	560.98
312.07	374.48	436.90	499.31	561.73
312.49	374.98	437.48	499.98	562.47
312.91	375.49	438.07	500.65	563.23

Areas of Circles and

Diam. in Inches.	DEPTH.			
	1	2	3	4
150.0	62.6648	125.33	187.99	250.66
.1	62.7483	125.50	188.24	250.99
.2	62.8320	125.66	188.50	251.33
.3	62.9157	125.83	188.75	251.66
.4	62.9994	126.00	189.00	252.00
.5	63.0832	126.17	189.25	252.33
.6	63.1671	126.33	189.50	252.67
.7	63.2510	126.50	189.75	253.00
.8	63.3350	126.67	190.01	253.34
.9	63.4190	126.84	190.26	253.68
151.0	63.5030	127.01	190.51	254.01
.1	63.5872	127.17	190.76	254.35
.2	63.6714	127.34	191.01	254.68
.3	63.7556	127.51	191.27	255.02
.4	63.8400	127.68	191.52	255.36
.5	63.9243	127.85	191.77	255.70
.6	64.0087	128.02	192.02	256.03
.7	64.0932	128.19	192.28	256.37
.8	64.1777	128.35	192.53	256.71
.9	64.2623	128.52	192.79	257.05
152.0	64.3470	128.69	193.04	257.39
.1	64.4316	128.86	193.29	257.72
.2	64.5164	129.03	193.55	258.06
.3	64.6012	129.20	193.80	258.40
.4	64.6861	129.37	194.06	258.74
.5	64.7710	129.54	194.31	259.08
.6	64.8560	129.71	194.57	259.42
.7	64.9410	129.88	194.82	259.76
.8	65.0261	130.05	195.08	260.10
.9	65.1112	130.22	195.33	260.44

Contents of Cylinders, *&c.*

DEPTH.				
5	6	7	8	9
313.32	375.98	438.65	501.31	563.98
313.74	376.49	439.24	501.98	564.73
314.16	376.99	439.82	502,66	565.49
314.58	377.49	440.41	503.32	566.24
315.00	377.89	440.89	503.89	566.99
315.42	378.50	441.58	504.66	567.75
315.84	379.00	442.17	505.34	568.50
316.26	379.51	442.76	506.01	569.26
316.68	380.01	443.35	506.68	570.02
317.10	380.51	443.93	507.35	570.77
317.52	381.02	444.52	508.02	571.53
317.94	381.52	445.11	508.70	572.28
318.36	382.03	445.70	509.37	573.04
318.78	382.53	446.29	510.04	573.80
319.20	383.04	446.88	510.72	574.56
319.62	383.54	447.47	511.39	575.32
320.04	384.05	448.06	512.06	576.07
320.47	384.56	448.65	512.74	576.84
320.89	385.06	449.24	513.42	577.59
321.31	385.57	449.83	514.10	578.36
321.74	386.08	450.43	514.78	579.12
322.16	386.59	451.02	515.45	579.88
322.58	387.10	451.61	516.13	580.64
323.01	387.61	452.21	516.81	581.41
323.43	388.12	452.80	517.49	582.17
323.86	388.63	453.40	518.17	582.94
324.28	389.14	453.99	518.85	583.70
324.71	389.65	454.59	519.53	584.47
325.13	390.16	455.18	520.21	585.23
325.56	390.67	455.78	520.89	586.00

Areas of Circles and

Diam. in Inches.	DEPTH.			
	1	2	3	4
153.0	65.1964	130.39	195.59	260.78
.1	65.2817	130.56	195.84	261.12
.2	65.3670	130.73	196.10	261.47
.3	65.4523	130.90	196.36	261.81
.4	65.5377	131.07	196.61	262.15
.5	65.6232	131.25	196.87	262.49
.6	65.7088	131.42	197.12	262.83
.7	65.7943	131.59	197.38	263.18
.8	65.8800	131.76	197.64	263.52
.9	65.9657	131.93	197.90	263.86
154.0	66.0514	132.10	198.15	264.20
.1	66.1372	132.27	198.41	264.55
.2	66.2231	132.45	198.67	264.89
.3	66.3090	132.62	198.93	265.24
.4	66.3950	132.79	199.19	265.58
.5	66.4810	132.96	199.44	265.92
.6	66.5671	133.13	199.70	266.27
.7	66.6533	133.31	199.96	266.61
.8	66.7395	133.48	200.22	266.96
.9	66.8257	133.65	200.48	267.30
155.0	66.9120	133.82	200.74	267.65
.1	66.9984	134.00	200.99	267.99
.2	67.0848	134.17	201.25	268.34
.3	67.1713	134.34	201.51	268.68
.4	67.2578	134.51	201.77	269.03
.5	67.3444	134.69	202.03	269.38
.6	67.4311	134.86	202.29	269.72
.7	67.5178	135.03	202.55	270.07
.8	67.6045	135.21	202.81	270.42
.9	67.6913	135.38	203.07	270.76

Contents of Cylinders, *&c.*

DEPTH				
5	6	7	8	9
325.98	391.18	456.37	521.57	586.76
326.41	391.69	456.97	522.25	587.53
326.84	392.20	457.57	522.94	588.30
327.26	392.71	458.16	523.62	589.07
327.69	393.22	458.76	524.30	589.83
328.12	393.73	459.36	524.98	590.61
328.54	394.24	459.96	525.66	591.37
328.97	394.76	460.56	526.35	592.15
329.40	395.28	461.16	527.04	592.92
329.83	395.79	461.76	527.72	593.69
330.26	396.31	462.36	528.41	594.46
330.69	396.82	462.96	529.10	595.23
331.12	397.34	463.56	529.78	596.01
331.55	397.85	464.16	530.47	596.78
331.98	398.37	464.77	531.16	597.56
332.41	398.89	465.37	531.85	598.33
332.84	399.40	465.97	532.54	599.10
333.27	399.92	466.57	533.22	599.88
333.70	400.43	467.17	533.91	600.65
334.13	400.95	467.78	534.60	601.43
334.56	401.47	468.38	535.30	602.21
334.99	401.99	468.99	535.98	602.98
335.42	402.50	469.59	536.67	603.76
335.86	403.03	470.20	537.37	604.54
336.29	403.54	470.80	538.06	605.31
336.72	404.06	471.41	538.75	606.10
337.16	404.59	472.02	539.45	606.88
337.59	405.10	472.62	540.14	607.65
338.02	405.62	473.23	540.83	608.44
338.46	406.15	473.84	541.53	609.22

20 AP 63

THE
Deſcription and Uſe
OF THE
Table of the Areas of Circles
AND
Contents of Cylinders in Ale Gallons.

BRITISH MUSEUM

THIS Table conſiſts of ten Columns, in the firſt you have the Diameters of Circles, beginning with 12, and continued in the firſt Column of each Page in Inches and Tenths of an Inch, to 156 Inches; the other nine Columns are numbered at the Top, with 1, 2, 3, 4, 5, 6, 7, 8, 9.

Under 1 at the Top of the ſecond Column, and againſt the given Diameter in the firſt, you have the Areas of Circles at one Inch deep, to the ten thouſandth Part of an Ale Gallon; in the next Column under 2, you have the Content at two Inches deep; under 3, you have it at three Inches deep, *&c.* to nine Inches deep in the laſt Column under 9.

Now theſe Figures, upon Occaſion, may repreſent 10, 20, 30, 40, 50, 60, 70, 80, or 90; and, when they do ſo, then the Contents that you find under them, and in the ſame Line with the given Diameter, muſt be multiplied by 10; which is done by only moving the Point, or Prick, one Figure further towards the Right Hand.

EXAMPLE I.

Let the Diameter of a Circle be 45 Inches, the Area in Ale Gallons is required?

Look in the firſt Column for 45, and in the ſame Line under 1 you will find 5.6398, which is the Area required.

Again, ſuppoſe the given Diameter to be 45.8 Inches; find 45 in the firſt Column, and for eight Tenths under that; then in the ſecond Column you'll find 5.8421, which is the Area required?

EXAMPLE II.

Given the Diameter of a cylindrical Tun 36.7 Inches, and Depth 8 Inches, the Content is required.

Seek for 36.7 in the firſt Column; againſt that, and under 8 at the Top, you have 30.01, for the Content. Where note, that, if this Tun had been 80 Inches deep, then it would have been ten times more than what was found above; and, to make it ſo, you muſt move the Point one Figure further towards the Right Hand, and then it will be 300.1, for the Content at that Depth; or if the Depth had been eight Tenths, then the Point muſt have been moved one Figure more to the Left Hand, and that would make it 3.001, for the Content in Ale Gallons at that Depth.

EXAMPLE III.

Let the Diameter of a Cylinder be 58 Inches, and the Depth 34.7 Inches, What's the Content in Ale Gallons?

Find 58 in the firſt Column, and in the ſame Line under 3 you have 28.11; and, by moving the Point one Figure towards the Right Hand, makes it 281.1, which is the Content at 30 Inches deep: Set this down as under.

Again, in the ſame Line againſt 58, and under 4, you have 37.48: Set this under the former. Then for the ſeven Tenths take what you find under 7, which is 65.58; but here you muſt remove the Point one Figure further towards the Left Hand, and it will be 6.558: Set this down.

Content	at 30 Inches deep - - - - -	281.1
	at 4 Inches deep - - - - -	37.48
	at 7 Tenths deep - - - - -	6.558
	The Sum is the Content of the Cylinder - -	325.138

EXAMPLE IV.

Let the Diameter of a Cylinder be 64 Inches, and Depth 42.4 Inches, What's the Content in Ale Gallons?

Againſt 64, and under 4, you have 45.63; and, by moving the Point one Figure towards the Right Hand, 'tis - - - -	456.3
Again, in the ſame Line under 2 you have -	22.82
And under 4 you'll find 45.63; and, by moving the Point one Figure towards the Left Hand, makes it - - - - - -	4.563
The Sum is the Content in Ale Gallons - -	483.683

EX-

EXAMPLE V.

There is a Caſk whoſe mean Diameter is 34.6 Inches, and Length 48, What's the Content in Ale Gallons?

Againſt the Diameter 34.6, and under 4, you have 13.34, make it - - - - - } 133.4
And in the ſame Line under 8 you have - - 26.67

The Sum is the Content in Ale Gallons - - 160.07

Now if you would know how many Wine Gallons this Caſk will hold, ſay as 9 is to 11, ſo is 160.07 to 195.64 Gallons of Wine.

EXAMPLE VI.

There is a Cone, whoſe Diameter at the Baſe is 40 Inches, and Heighth 60 Inches, What's the Content in Ale Gallons?

Againſt the Diameter 40, and under 20, which is one Third of the Heighth, you have 8.91; and, by moving the Point, it is - - - } 89.1 the Content.

EXAMPLE VII.

There is a parabolick Conoid, whoſe Diameter at the Baſe is 40 Inches, and Heighth 60; Half of this is 30, What's the Content in Ale Gallons?

Againſt the Diameter 26 in the firſt Column, and under 3 in the ſame Line, you have 13.37; make it 133.7, and this is the Content.

EXAMPLE VIII.

There is an hyperbolick Conoid, whoſe Diameter at the Baſe is 26 Inches, and Heighth 48; five Twelfths of this is 20 Inches, What's the Content in Ale Gallons?

Againſt the Diameter 26 in the firſt Column, and under 2, you have 3.77; make it 37.7 for the Content required.

EXAMPLE IX.

There is a Spheroid, whoſe conjugate Diameter is 42 Inches, and tranſverſe Diameter 60; two Thirds of which is 40 Inches, What's the Content?

Againſt the conjugate Diameter 42, and under 4, you have 19.65; make it 196.5, and this is the Content required in Ale Gallons.

EXAMPLE X.

There is a Sphere, whoſe Diameter is 36 Inches, What's the Content in Ale Gallons?

Two Thirds of the Diameter is 24, then	
Againſt the Diameter 36, and under 2, you have 7.22; make it - - - - - - - - -	72.2
And in the ſame Line under 4 you have - -	14.44
The Sum is the Content - - - - - - - - -	86.64

EX-

EXAMPLE XI.

Let there be a Fruſtum of a Cone, whoſe Top Diameter is 30 Inches, the Bottom Diameter 40, and Depth 60, What's the Content in Ale Gallons?

		Inches.	
Diameter	at the Top	30	
	at the Bottom	40	
	Sum	70	
	Half Sum	35	mean Diameter.

Againſt the mean Diameter 35, and under 6, you have 20.47; and by moving the Point one Place more to the Right Hand, it is 204.7, for the Content required.

And tho' this Method is not ſo exact as that which you have in the former Part of this Book, yet it may diſcover any conſiderable Miſtake that might happen in working that Way.

20 AP 63

FINIS.

er
o,

ve
ne

on
er
g